1953

PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume 50 Issued May 15th, 1954

	Page
Hatch—The Broader Implications of the Development of Entomology in the Pacific Northwest	7
Hardy—Notes on the Life History of the Shaded Umber Nephelodes emmedonia Cram.	15
Hardy—Notes on the Life Histories of Epirrhoe plebeculata Gn. and Euphyia lacteata Pack.	17
Hardy—Notes on the Life History of Coryphista meadi Pack. and Form badiaria Hy. Edw.	31
McLeod—Statuses of some Introduced Parasites and Their Hosts in British Columbia	19
Richmond—Forest Insect Surveys	28
Spencer—Two Decades of Household Pests in Vancouver: A Summary of Enquiries	32
Science Notes	16, 37

They deal with a Basic Producer

How About You?

More and more buyers of agricultural chemicals are finding out there are real advantages in dealing with a basic producer. Pennsalt customers, for example, know four good reasons:

1. They have complete confidence in the quality of the Pennsalt products they buy.
2. They get prompt fulfillment of their orders from the very company that makes the product.
3. They know they are buying *effective* chemicals because every Penco product has been thoroughly tested either at the famous Whitemarsh Research Laboratories, or in the field, by competent research workers.
4. They are assured of a dependable supplier for the products they need—even through unusual economic conditions.

It's all summed up in the name PENCO—the name proudly applied to this line of top-quality, basic agricultural chemicals. It will pay you to know more about the Penco line, too! Write for full details.

Technical Chemicals and Concentrates for Agricultural Use

Agricultural Chemicals Dept.

Pennsalt Chemicals

INSECTICIDES
HERBICIDES
FUNGICIDES

Pennsylvania Salt Manufacturing Company of Washington

Wenatchee Yakima Tacoma Portland

The *Right* Product for *Every* Pest Problem

INSECTS

PLANT DISEASES

WEEDS

Canada's foremost line of

Insecticides
Miticides
Fungicides
Herbicides

Available throughout Canada.
See your friendly Orchard Brand Dealer.

NICHOLS CHEMICALS FOR CANADA

The NICHOLS CHEMICAL COMPANY, Limited

1917 Sun Life Bldg., Montreal 2 • 137 Wellington St., W., Toronto 2 • Vancouver (Burnet, B. C.)

In Appreciation . . .
Green Valley

appreciates the many courtesies extended to the technical sales staff of our company by the entomologists working in B. C. on the various phases of insect control.

It is only through such co-operation that we in GREEN VALLEY can maintain with confidence our policy of offering to the B. C. consumer the most efficient products and latest approved measures for insect control.

GREEN VALLEY

GREEN VALLEY FERTILIZER & CHEMICAL CO. LTD.
NEW WESTMINSTER, B.C.

IMPROVED CONTROLS FOR ENTOMOLOGISTS

D.D.T. FORMULATIONS
D. Dust 5%
D.D.T. 50% Wettable
D.D.T. 25% Emulsifiable

SOIL FUMIGANTS
Dowfume 485
Dowfume M.C. 2
Larvacide

CYPRO PRODUCTS
(Contain "Pyrenone")
Cypro Dust
Cypro Mill Spray
Cypro Emulsion Concentrate
Nontox Livestock Spray

CHLORDANE
Chlordane 65% Emulsion Concentrate
Chlordust 5%

B.H.C.
Gamma Dust .5 (Lindane)
Lindane 25% Wettable

MILL & GRAIN FUMIGANTS
Methyl Bromide
Dowfume E.B. 5
Dowfume E.B. 15
Dowfume 75

METHOXYCHLOR 50% Wettable

Commercial Chemicals Limited
DIVISION OF
STANDARD CHEMICAL COMPANY, LIMITED
Pier H, Ft. of Carrall Street, Vancouver 4, B.C.

malathion

(*O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate*)

an organic phosphate

low mammalian toxicity

high insect toxicity

MALATHION is a very effective organic phosphate insecticide. Chemically, it is similar to Parathion, but it has a low toxicity to warm-blooded animals, which gives a wide margin of safety.

Malathion has proven very effective against a large number of injurious insects in Canada and the United States. It is specially suitable for the control of aphids, mites and certain scale insects.

Entomologists are constantly finding new uses for this important new insecticide. They have tested it for plant tolerance on a large number of fruit, vegetable and field crops, and on ornamentals. It has been demonstrated to be less injurious to crops than many other insecticides.

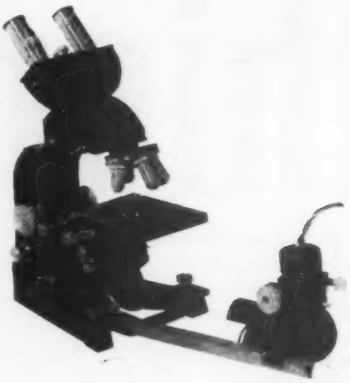
Residues of it are dissipated very rapidly, which makes Malathion most suitable for control of insects on edible crops. Additionally, flavour evaluation tests of it have shown Malathion to be less flavour-imparting than many other standard pest control treatments.

A new Technical Bulletin is available for distribution to interested entomologists and others.

NORTH AMERICAN Cyanamid LIMITED

AGRICULTURAL CHEMICALS DIVISION

ROYAL BANK BUILDING TORONTO 1.



REICHERT

The World's Finest Microscopes

FOR PROMPT SHIPMENT
FROM THE LARGEST STOCKS IN CANADA

Exclusive Distributors

CAVE and COMPANY LIMITED

567 Hornby Street
VANCOUVER 1, B.C.

199 - 2E College Street
TORONTO, ONTARIO

Stauffer CHEMICALS
SINCE 1885

You can depend on

STAUFFER

for the Most Complete Line
of Agricultural Chemicals
in the Pacific Northwest

STAUFFER CHEMICAL CO.

PACIFIC NORTHWEST DIVISION
NORTH PORTLAND, OREGON

PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume 50 **Issued May 15th, 1954**

	Page
Hatch—The Broader Implications of the Development of Entomology in the Pacific Northwest	7
Hardy—Notes on the Life History of the Shaded Umber Nephelodes emmedonia Cram.	15
Hardy—Notes on the Life Histories of Epirrhoe plebeculata Gn. and Euphyia lacteata Pack.	17
Hardy—Notes on the Life History of Coryphista meadi Pack. and Form badiaria Hy. Edw.	31
McLeod—Statuses of some Introduced Parasites and Their Hosts in British Columbia	19
Richmond—Forest Insect Surveys	28
Spencer—Two Decades of Household Pests in Vancouver: A Summary of Enquiries	32
Science Notes	16, 37

DIRECTORS OF THE ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA
1953 - 1954

Honorary President
W. H. ROBERTSON, Victoria, B.C.

President
J. H. MCLEOD, Vancouver, B.C.

Vice-President (Coast)
M. H. HATCH, Seattle, Wash.

Vice-President (Interior)
J. D. GREGSON, Kamloops, B.C.

Hon. Secretary-Treasurer
C. L. NEILSON, *Vernon, B.C.*

Advertising and Hon. Auditor
D. A. ROSS, Vernon, B.C.

Advisory Board
M. H. HATCH, Seattle, Wash. R. H. HANDFORD, Kamloops, B.C.
G. J. SPENCER, Vancouver, B.C.

Editorial Committee
W. DOWNES (Chairman) J. MARSHALL
K. M. KING

Librarian
H. R. MCCARTHY, Kamloops, B.C.

NEW MEMBERS

B. Ainscow
G. C. Carl
D. G. Denning
Alan Jenkins
P. A. Jones
R. P. Murray
D. P. Pielou
J. Raine
A. L. Turnbull
Henry Twiddle

CHAPMAN & WARWICK LIMITED

COMMERCIAL STATIONERS
PRINTERS AND BOOKBINDERS

569 Seymour Street *Vancouver 2, B.C.*

THE BROADER IMPLICATIONS OF THE DEVELOPMENT OF ENTOMOLOGY IN THE PACIFIC NORTHWEST

MELVILLE H. HATCH

University of Washington, Seattle, Wn.

For some years the writer has been interested in the history of entomology in the Pacific Northwest. In 1949 the University of Washington Press issued the result of his studies under the title, "A Century of Entomology in the Pacific Northwest", and since then he has published a number of shorter historical studies. Moreover, the 1952 issue of the Proceedings of the Entomological Society of British Columbia contained a number of papers on the development of entomology in that portion of the Northwest. At the present time, accordingly, there seems no point in merely summarizing again what has been said before. Rather it seems more challenging at this juncture to carry the enquiry to the stage where the attempt is made to extract from the history something of its general significance. I propose to proceed by asking a series of questions about the development of entomology in this region in the hope that light will be shed on the subject by thus considering it from diverse points of view.

My basic assumption is that a science like entomology does not develop in a vacuum but is a part of a complex social process related to a complex array of factors in the environment in which it develops. As entomologists, we are well aware that the insects that we study are complexly related to the environment in which they occur. It is similarly true that the very fact that we are studying insects rather than, for instance, debating how many angels can dance on the head of a pin, is the result of complex factors in the sociological environment.

(An address given at the Annual Meeting of the Entomological Society of Canada, Victoria, B.C., October 19, 1953; in part based on an address given in a Symposium on the Development of Entomology in the West at the Pacific Coast Branch Meeting of the Entomological Society of America at Lake Tahoe, Calif., June 24, 1953.)

First, then, I ask: What is the over all position of the Pacific Northwest in regard to the development of entomology?

Entomology arose as part of that awakening interest in nature that occurred in Western Europe in the sixteenth century. The first insects were not taken in the Pacific Northwest until the beginning of the second third of the nineteenth century, and it was another forty or fifty years before an indigenous study of insects began to appear in our region. As regards both time and geography, then, entomology in the Pacific Northwest occupied a peripheral position, far removed from the central mainsprings of our western European culture.

The Pacific Northwest was one of the last portions of the North American continent to be claimed by men of European descent. California and Alaska had been occupied by Spain and Russia in the eighteenth century, but the first trading posts were not established in the intervening region until about 1808.

Modern natural history, as has been said, arose in Western Europe in the sixteenth century. The first studies were concerned with the more conspicuous plants and vertebrates, but by the end of the century a manuscript on the less conspicuous insects was being put together by a series of English naturalists, and Ulysses Aldrovandus, Professor of Natural History at the University of Bologna in northern Italy, was at work on his vast compendium, *de Animalibus Insectis*, which saw publication in 1603. A small but increasing number of books on insects appeared in the seventeenth and early eighteenth centuries, laying one of the bases for the *Systema Naturae*, in the middle of the eighteenth century, of the great Swedish Naturalist, Carolus Linnaeus, in the 1758 edition of which its

author gave relatively precise descriptions of some 4400 species of animals, including about 2100 insects. Thus, seventy-five years before the first insects were collected in the Pacific Northwest, Linnaeus had created a mature science of insects and had devised the method whereby, eventually, the million or so different species of insects may be classified.

Meanwhile, Linnaeus' pupil, the Dane, Johan Christian Fabricius, had specialized on the insects and had thus become the first strict entomologist. In eastern North America, Thomas Say had described some 1575 new species of insects between 1818 and 1834, and Dr. T. W. Harris, the librarian of Harvard, had published a catalogue of 2350 species of insects from Massachusetts in 1833 and would in 1841 publish the first American book on harmful insects, "A Report on the Insects of Massachusetts Injurious to Vegetation."

It was, accordingly, against the background of a mature but rapidly growing entomology that the first insects were collected in the lower Columbia River Valley about 1835. And it is not surprising to realize that the history of entomology in the Northwest has consisted in the main of a series of reactions to cultural influences of western European and eastern North America origin.

My second question is: What are the general features of Northwestern entomology as it actually developed?

As already noted, insects are relatively inconspicuous and their study tends to follow on that of the plants and vertebrates. Thus, the first scientific observations on Northwestern natural history were those made by Archibald Menzies, surgeon accompanving the Vancouver Expedition, in the 1790's, followed by additional observations by Lewis and Clark and others. Similarly at the present time, Northwestern plants and vertebrates are described in numerous detailed manuals, whereas the insects have so far been only rather sketchily listed, with only the barest beginning of descriptive works.

The beginning of the study of insects in the region dates from the first scientific collection of specimens in the lower Columbia River Valley about 1835. For thirty years all the insects taken in the region were by itinerant collectors who were not themselves entomologists, but transmitted their materials to specialists in Northwest Europe and Northeastern United States. Only with the seventies did two or three entomologists pass through the region, and the same decade saw O. B. Johnson living in the Willamette River Valley and G. W. Taylor on southern Vancouver Island. These were the pioneer resident entomologists of the region. The eighties saw O. B. Johnson commencing the teaching of entomology at the University of Washington in Seattle. The nineties saw the establishment of agricultural experiment stations at Pullman, Washington; Moscow, Idaho, and Corvallis, Oregon, with the beginning of investigational work in applied entomology.

The turn of the century witnessed the beginning of original work in insect taxonomy by J. M. Aldrich at Moscow and Trevor Kincaid at Seattle, joined later by G. W. Taylor at Nanaimo and A. L. Melander at Pullman. The nineteen tens witnessed the establishment by the federal governments of both the United States and Canada of permanent laboratories for investigations in applied entomology. In the United States these laboratories supplement the work of the states, but in British Columbia they have preempted nearly the entire field. Finally, by the 1920's the economic work in the region was so well established that occasional discoveries of national significance began to appear. After ninety years, Northwestern entomology had begun to come of age!

What have been the economic and cultural bases of Northwestern entomology? For no sort of science flourishes in a vacuum, but is related to other aspects of the culture.

The first Northwestern insects were collected as a by-product of the unsuccessful attempt of a business man

of Boston to break into the Northwestern fur trade. The next insects to be gathered—those taken in 1841 by Dr. Charles Pickering and Titian R. Peale—were an outcome of the New England whaling industry. At least, I suggest that whaling was an important factor in inducing Congress to send the Wilkes Exploring Expedition to the Antarctic and the Pacific, and Pickering and Peale were among the naturalists on this expedition. From 1853 to 1856, insects were taken by the Railway Surveys, which the American Government organized in order to keep the communities of an expanding western frontier integrated with the life of the rest of the country. And specimens secured between 1857 and 1864 were taken by the parties surveying the international boundary between the United States and Canada.

Of course, the very fact that the fur trade, the whaling industry, and the railroad and boundary surveys produced insects for scientific study was itself the result of cultural tendencies then long at work in the Atlantic community. The awakening interest in nature to which the 16th century had given birth came to permeate the highest circles of European society. To this the Royal Society of England and the Academies supported by the French, Prussian, and Russian governments bore witness. Moreover, in the persons of Benjamin Franklin and Thomas Jefferson, the new American republic had come into contact with the best continental traditions. The result was that, as the United States felt its way westward and as the Anglo-Canadian governments joined with it, scientific exploration became an integral part of geographical and commercial exploration.

With the early seventies, amateurism entered the picture—the industrial wealth of Great Britain made it possible for a Lord Walsingham to spend a year in northern California and Oregon collecting microlepidoptera and the Anglo-American coleopterist, George Robert Crotch, to collect beetles. By the seventies, moreover, life in the pioneer communities had become sufficiently established so that an occasional immigrant in very ordinary economic circumstances, like O. B. Johnson and G. W. Taylor, took up the study of insects. A decade later academic entomology became established at the as yet very tiny University of Washington.

The intrusion of applied entomology on the Northwestern scene had diverse roots. The sort of insect study that up to this time had operated in our area was the working out of the spirit and genius of Linnaeus in seeking to subject the works of the Creator to a rational ordering. But not the Swede, Linnaeus, but the Frenchman, Antoine Lavoisier, was the greatest scientist of the eighteenth century, and not Linnaeus, again, but the great Englishman, Charles Darwin, who was the biologist who was destined to leave the most indelible stamp on the modern world. It was the experimental techniques employed by Lavoisier in virtually founding the science of chemistry that in the course of two or three generations began to make an effective science of agriculture possible. And it was the evolutionist Darwin who showed that insects were something more than jewels fresh from the hand of the Creator, that they were veritable parts of the processes of nature, to be understood and controlled. Moreover, an advancing agriculture was intensifying its entomological problems, gradually bringing in additional pests from distant parts of the world and, by growing crops in ever more extensive continuous stands, producing ideal conditions for the multiplication of insects.

Harris' 1841 "Report on the Insects of Massachusetts Injurious to Vegetation" was a recognition of the problem. The 1854 appointment of Townsend Glover as federal entomologist by the United States government followed by the appointment by New York, Illinois, and Missouri, of state entomologist in 1856, 1867, and 1868, was acknowledgment by government that insects were of public concern. Finally, the spectacular control of the Colorado potato beetle by Paris Green in the sixties and the control of the

grape Phylloxera by the use of resistant hosts in the seventies showed what entomological research could accomplish. The result was an accumulation of pressures making for government participation in combating insects as part of the general promotion of applied agriculture.

In the late eighties, the American Congress was induced to pass the Hatch Act matching state with federal funds in maintaining an Agricultural Experimental Station in each of the states and territories. This led to the establishment of research and teaching in applied entomology in each of the Northwestern states. The pressure on the federal government to aid agriculture was not satisfied with this direct help to the states, however, so that from the early nineties special agents were sent into the states who worked in close conjunction with the several state entomologists on special entomological problems. By 1910 the federal agents were spending two or three years at a time in the region. The work of these agents continued to expand, until, with the second decade of the present century, semi-permanent federal laboratories were established on both sides of the border: at Agassiz, Victoria, and Vernon, in British Columbia, at Wenatchee and Ritzville in Washington, and at Ashland and Forest Grove in Oregon. In British Columbia the federal agency virtually supplanted the provincial entomological service, except for instructional work carried on at the University of British Columbia after 1919. South of the border, the federal and state services have coexisted and collaborated with each other closely. In these ways the economic resources of an entire continent have been brought to bear on the agricultural problems of one of the less densely populated portions.

Accordingly, since the nineties, the continuing importance of a knowledge of insects in the maintenance and development of agriculture and forestry has been the main factor in promoting the study of Northwestern entomology. Academic entomology remains at the University of Washington, where we have virtually the strongest entomological library in the Northwest and where there are no economic involvements except for some recently introduced very elementary instruction in the College of Forestry. Seven or eight amateur entomologists of importance reside at various localities in our territory, but in general, applied entomology has dominated the field.

Northwestern entomology acquires additional interest for the student of cultural history from the fact that the region in which it operates is traversed by an international boundary. Because of the different political affiliation of the two regions, the area south of the border was settled by persons from the eastern United States, a generation or several removed from their European ancestors. Moreover, the diversity of cultural traditions represented by the people of the eastern United States was reflected in the settlers in general and the entomologists in particular. North of the border, on the other hand, a preponderance of the settlers was of British birth and brought their British traditions with them to their new home. Paramount among these traditions, from an entomological point of view, was a more general interest in nature and a wide-spread amateurism characteristic of the older more settled society from which they came. It was, perhaps, the continuation of the eighteenth century tradition that had produced Gilbert White's "Natural History of Selborne," 1788, at a time when Americans were making homes for themselves in a primeval wilderness.

In line with this tradition, there were, among the early entomologists of British Columbia, three clergymen: on Vancouver Island, Henry Matthews in the sixties and G. W. Taylor in the eighties and later; on the Queen Charlotte Islands, J. H. Keen in the nineties. One looks almost in vain for clergymen pursuing entomology on the American scene!

A vigorous amateurism, again, was involved in the organization and early years of the Entomological Society of British Columbia in Vancouver in 1902, and the consistency with which the

British Columbians have gotten their findings into print. The published proceedings of their Society gave them the vehicle and their amateur attitude gave them the drive for publishing their results. Many of these amateurs, it is true, later secured professional positions in the Dominion Entomological Service, but at a period in their lives too late to alter their basic attitudes. The outcome has been that, in the period since 1880, and virtually up to the present, a preponderance of the non-economic literature references to Northwestern insects refer to the British Columbia fauna. But the years effect changes. The amateur attitude does not apparently persist in the face of the increased efficiency of greater professionalism, and the time may soon be at hand when such differences as are referred to here may no longer distinguish the entomological work on the two sides of the border. Another influence of the border is seen in the personnel of the professional entomologists to the north and south of it. Because of the border and because of the control of the two federal services from Ottawa and Washington respectively, the movement of personnel tends to be east and west and not north and south. Moreover, the contacts with British entomology is far closer in British Columbia than in the states. The results are probably beneficial, tending to maintain a diversity of entomological outlook that otherwise might be absent.

Another way in which the international border has affected entomology is economic. The fact that Washington, Idaho, and Oregon are an integral part of the mid-twentieth century's greatest political, economic and military power, as well as the further circumstance that they are favorably situated with regard to agricultural, commercial and increasingly, to industrial wealth, means that, in the long run, tremendous economic resources are available for the study of entomological problems. The favorable present position of the University of Washington as regards library resources in entomology is one of the results of this economic power. The time will come, I suspect, when it will be regarded as strange that this Northwest country—one, as it is, in geography, in language, in flora, in fauna, and in basic economic relationships—should be divided, even to the extent that it is, by an invisible political boundary, and that its essentially similar entomological problems north and south of the 49th parallel should, in part, be administered separately from Ottawa and from Washington.

Another question that can be asked is: To what extent is the Pacific Northwest a natural unit for the consideration either of historical processes relative to the study of insects or to the study of insects themselves.

In my 1949 study of Northwestern entomology and in my forthcoming book on beetles, I have adopted British Columbia, Washington, Idaho, and Oregon as my unit for study. Faunistically, the area is only approximately natural, and southeastern Alaska and Montana west of the continental divide are integral parts of it, excluded for practical considerations. To the south, the area shades off gradually, especially in the mountains. In general, however, I suggest that the Arctic area to the north, the Great Plains east of the Rocky Mountains, and the Great American Desert to the south delimit the Pacific Northwest as a natural entomological region. In addition to these theoretical considerations, there is the following practical one for taking the Pacific Northwest as an area for study. Entomological problems, including those having to do with entomological history, are so complex that they must be broken down in various ways for analysis and study. Our primary political units, the United States and Canada, are too large and unwieldy for many types of studies. In Europe, regions like the British Isles, France, Italy, or Germany have repeatedly proven useful for detailed analysis. The Pacific Northwest represents a similar unit, one of the same order of size as the European area mentioned. The cultural effect of the international border has already been noted. I suggest,

however, that similar north and south extending climatic and faunal zones involving similar crops and similar entomological problems, unite far more effectively than the border separates.

What have been the principal organizations that Northwestern entomologists have set up in order to expedite the prosecution of their entomological activities? Oldest and most important is the Entomological Society of British Columbia. Founded in Vancouver, in 1902, revived in 1911 by R. C. Treherne, this society has by its annual meetings and long series of publications promoted the entire field of entomology in the more northern portions of the Pacific Northwest. Similar in scope, but much more recent in origin, is the Oregon Entomological Society. Founded in 1939, under the sponsorship of the Oregon State College, it meets four or five times a year at various places in the Willamette Valley, issues a mimeographed *Bulletin* of proceedings, and co-ordinates effectively the activities of both amateur and professional entomologists.

Since the 1900's economic entomologists have participated in the annual meetings and publications of the state horticultural societies of Washigton and Oregon, and since 1918 the Northwest Association of Horticulturists, Entomologists, and Plant Pathologists has met annually for the reading of papers and informal discussions. Since 1926 the Western Co-operative Oil Spray Project, for many years under the chairmanship of E. J. Newcomer, has held informal annual meetings in various Northwestern cities. No formal recommendations have emerged from these meetings, but their informal findings have constituted the basis of all official spray recommendations made in the Pacific Northwest, and it is the considered opinion of some that this conference has done more for applied entomology in the Northwest than any other single organization. Its success led to the formation along similar lines of a Pea Weevil Control Conference in 1936, reorganized six years later as the Pacific Northwest Truck Crop Insect Control Conference. An annual Pacific Northwest Pest Control Operators Conference, organized at Corvallis in 1950, may come to play a similar role in that field of applied entomology.

The crucial question to be asked concerning Northwestern entomology pertains to the nature of its contributions to man's understanding of the insects. This is a question that the present author is able to answer only in part and imperfectly.

First, there is the matter of the Northwest insect fauna, the aspect of Northwestern entomology with which the speaker has been most concerned. During the first thirty or forty years of Northwestern entomology the insects collected and reported on were mostly Coleoptera, of which LeConte issued a list of 233 species in 1857 and of which perhaps as many, 500 or 600, were known from the region by 1880. By the nineties, however, the British Columbians were becoming especially interested in the Lepidoptera, resulting in 1904 in a catalogue of 1128 species that was issued by the Provincial Museum in Victoria. The same period saw less complete listings of groups of Hymenoptera, Diptera, Coleoptera, Trichoptera, Odonata, Neuroptera, and Orthoptera from British Columbia, so that by 1910 the Canadians were well on the way to a preliminary knowledge of their fauna.

This early work took the form largely of simple lists, in part, because the economic resources of these pioneer Northwestern entomologists did not permit them to assemble either the libraries or the collections necessary for descriptive work. They sent their specimens to specialists in the northeastern United States and eastern Canada, and frequently the extent of what they knew about them was represented by the names attached to the returned insects.

Not all the work, however, remained on this preliminary level. At the turn of the century the two most outstanding entomologists in the Northwest were probably Trevor Kincaid of the University of Washington and John Merton Aldrich of the University of Idaho. These men, to be

joined shortly by A. L. Melander of the Washington State College and the Rev. G. W. Taylor of the Nanaimo Biological Station, were the first to show that entomological work other than the mere listing of names assigned by others or the issuance of routine economic information was possible in this new country. Taylor in Geometridae and Aldrich and Melander and Kincaid in Diptera demonstrated beyond peradventure of doubt that entomological work of the most exacting sort was possible even in these far reaches of North America; and Aldrich's brusque dismissal from the University of Idaho in 1913 is a dark page in the history of Northwestern entomology. This northwest interest in Diptera spread to Oregon, where it resulted in Cole and Lovett's *List of the Diptera of Oregon* in 1921.

Somewhat analogous to the Aldrich-Melander Diptera studies was the Vernon "school' 'of Coleoptera studies at the Dominion Forest Insect Laboratory at Vernon, B.C., between 1919 and 1948. Here Ralph Hopping (1868-1941) and his son, George R. Hopping, produced a number of continent-wide studies of Cerambycidae, and Hugh B. Leech laid the foundations for his work on water beetles. I am informed that during this period Hopping's staff was encouraged to collect beetles in general and not just those of economic importance to the forest, with the result that, for better or for worse, a very fine collection was assembled, one that I am finding invaluable in my present studies. Now the pendulum swings in the other direction: not only does no general beetle collecting go on at the laboratory, but the forest beetles are being themselves neglected for other insect types such as the defoliators. In our own decade, the private studies of Kenneth and Dorothy Fender of McMinnville on the Lampyroid families of Coleoptera are likewise on a continent-wide scale. But such work has been scattered. The bulk of Northwestern taxonomic entomological activity has concerned the local fauna.

Whatever the administrators back in Ottawa and Washington, or in the presidents' or deans' chairs of the agricultural colleges may have intended to the contrary, the basic taxonomic problem as it relates to insects has come out; and there has been scarcely an entomological laboratory in the region that in one way or at one time or another has not made contributions —sometimes of an extensive nature— to the knowledge of the fauna. Large collections of Northwestern insects exist at the State College of Washington, the Oregon State College, the University of British Columbia, the University of Idaho, and, outside the Northwest, at the California Academy of Sciences, with an important collection of Coleoptera at the University of Washington—not to mention a number of collections in the hands of individuals and at certain of the experiment stations and federal laboratories.

One is tempted to make a generalization. In the early decades on economic work there is a tendency to recruit personnel in important measure from men who were attracted into entomology by the aesthetic appeal of insects and who have insisted on continuing this interest along with their strictly practical studies. Aldrich, Melander, Hopping, and others are examples of such men. As economic entomology has matured, however, numerous factors have combined to end this tendency. The methods open for the investigation of economic problems become more extensive and more preoccupying. Students are attracted into the field primarily by the opportunity it offers for earning a living rather than because it is a chance to work with insects in which they are already interested. Finally there comes a time when the administrators themselves have become thoroughly conditioned to such a view point and regulations are effected to see that all the foolishness with insect collections and insect nets—the badge of the dreamy impractical enthusiast —is relegated to the limbo of forgotten things!

Applied entomology in the Northwest began with a short series of letters by O. B. Johnson on a number

of insect pests, in the Willamette Farmer between 1874 and 1877. It got underway in earnest with the establishment of the state experiment stations in the early nineties, but for three decades was largely occupied with applying in the Northwest discoveries that had been made elsewhere. C. L. Metcalf, for instance, in his 1940 survey of entomological progress between 1909 and 1919, cited 73 names on his "roll of honor" for the decade. The only Northwesterner on the list was Aldrich, listed for his taxonomic work on Diptera, and he had been discharged from the University of Idaho in 1913! With the 1920's, however, the picture began to change, and some ten Northwesterners are among the more than 300 names cited in the bibliography in a special study by E. O. Essig of entomological progress in this decade. Essig's list may be of interest: Leroy Childs, F. R. Cole, B. B. Fulton, Eric Hearle, A. L. Lovett, A. L. Melander, O. M. Morris, R. A. Muttkowski, E. J. Newcomer, and R. C. Treherne. I leave to someone more competent the task of a comprehensive chronicle of Northwestern achievement in applied entomology.

Selected Bibliography

The following references on the development of entomology in the Pacific Northwest supplement the author's 1949 study.

Buckell, E. R. Records of bees from British Columbia: Andrenidae. Proc. Ent. Soc. B.C. 45, 1949: 27-30 (56 species); Megachilidae. 46, 1950: 21-31 (111 species); Bombidae. 47, 1951: 7-24 (30 species).

Buckell, E. R. and G. J. Spencer. The social wasps (Vespidae) of British Columbia. Proc. Ent. Soc. B.C. 46, 1950: 33-40 (11 species).

Clark, M. E. An annotated list of the Coleoptera taken at or near Terrace, B.C. Part 2. Proc. Ent. B.C. 45, 1949: 21-24, (Orthoperidae; 235 species).

Day, G. O. Presidential address. Proc. Ent. Soc. B.C. 4, 1914: 39-44.

Downes, W. Fifty years of Entomology on Vancouver Island. Proc. Ent. Soc. B.C. 48, 1952: 9-16.

Essig, E. O. Fifty Years of Entomological Progress, Part IV, 1919 to 1929. Jour. Econ. Ent. 33, 1940: 30-58.

Follwell, J. H. Notes on some Ptinidae of British Columbia (Coleoptera). Proc. Ent. Soc. B.C. 48, 1952: 60-62 (11 species).

Glendenning, R. Reminiscenses of Fifty Years of Entomology in the Lower Fraser Valley of B.C. Proc. Ent. Soc. B.C. 48, 1952: 16-19.

Gregson, J. D. The history of the Study of External Arthropods Affecting Animals and Man in British Columbia. Proc. Ent. Soc. B.C. 48, 1952: 22-24.

Handford, R. H. The Dominion Field Crop Insect Laboratory and its Work, Vernon, 1918-1938, and Kamloops, 1939-1950. Proc. Ent. Soc. B.C. 48, 1952: 31-33.

Hatch, Melville H. A Century of Entomology in the Pacific Northwest. 1949, 43 pp. 9 portraits (See review by W. Downes, Proc. Ent. Soc. B.C. 46, 1950: 40).

— Trevor Kincaid. Studies Honoring Trevor Kincaid. 1950: 1-10. Portrait.

— An Account of the Life of Orson Bennett Johnson. Loc. cit. 11-28. Portrait.

— The Young Naturalists Society (1879-19-5). Loc. cit. 29-34.

— Coleopterists and Coleoptera Collections in the Pacific Northwest. Proc. Ent. Soc. B.C. 47, 1951

— Observations on the Study of Beetles in British Columbia. 48, 1952: 76-80.

— The Beetles of the Pacific Northwest. Part I. Introduction and Adephaga. Univ. Wash. Press. 1953 (about 675 species).

Holland, George P. A revised check list of the fleas of British Columbia. Proc. Ent. Soc. B.C. 45, 1949: 7-14 (93 sp.).

Lane, M. C. List of the Elateridae of British Columbia. Proc. Ent. Soc. B.C. 48, 1952: 65-67 (150 species).

Marshall, J. Applied Entomology in the Orchards of British Columbia, 1900-1951. Proc. Ent. Soc. B.C. 48: 1952: 25-51.

Metcalf, C. L. Fifty Years of Entomological Progress, Part III, 1909 to 1919. Jour. Econ. Ent. 30, 1940: 21-30.

Olds, H. F. Fifty years of Plant Quarantine Legislation and Activities in B.C. Proc. Ent. Soc. B.C. 48, 1952: 34-36.

Spencer, G. J. The 1951 Status of our Knowledge of the Insects of British Columbia. Proc. Ent. Soc. B.C. 48, 1952: 36-41.

Ross, Herbert H. and George J. Spencer. A Preliminary list of the Trichoptera of British Columbia. Proc. Ent. Soc. B.C. 48, 1952; 43-51 (142 species).

Schmid, F .and Richard Guppy. An annotated list of Trichoptera collected on southern Vancouver Island. Proc. Ent. Soc. B.C. 48, 1952: 41-42 (59 species).

Venables, E. P. Fifty years of Entomology in the Interior of British Columbia. Proc. Ent. Soc. B.C. 48, 1952: 19-22.

Waddell, D. B. A Preliminary List of the Hemiptera of the Kootenay Valley. Proc. Ent. Soc. B.C. 48, 1952: 93-96. (80 species).

NOTES ON THE LIFE HISTORY OF THE SHADED UMBER NEPHELODES EMMEDONIA CRAM. (F. PECTINATA SM.) LEPIDOPTERA: PHYLAENIDAE

GEORGE A. HARDY

Victoria, B.C.

This moth often turns up at my porch light in Saanich, B.C. during the month of August and September. In 1951 a female was captured and placed in a box within which she laid a batch of eggs. The following life-history notes were taken.

Ova. On August 29, 1951, 200 eggs were deposited loosely in the box. No cementing material was used; they were free to roll about whenever the box was tilted. The egg is spherical, 1 mm. in diameter, slightly flattened on opposite sides, like an orange, finely ribbed and cross-ribbed, white to cream in colour, changing to a dull pink or leaden hue by September 15, 1951 As no signs of hatching were observable on October 17, to ascertain their condition one or two eggs were dissected. This disclosed the young larvae fully developed and lying curled up in a dormant condition. Head pale brown, body more or less translucent.

1st Instar. Some hatched about February 16, 1952. Length 1.5 mm. Head pale brown, body light grey in colour. The egg shell is not eaten. I had difficulty in getting the larvae to feed despite a variety of plants in leaf at this time of the year. Finally they reluctantly took to *Bromus* sp.

2nd Instar. February 29, 1952. Length 4 mm. Head pale brown, body green, darker above than beneath, slightly translucent; a white broad spiracular line, followed by two narrow ones and a medium dorsal line of the same colour.

3rd Instar. March 12, 1952. Length 7 mm. Head and body similar to the last instar, but the white lines edged with black. Spiracular line creamy, spiracles black.

4th Instar. March 25, 1952. Length 12 mm. Colour as before but body darker and stripes more creamy and more pronounced; in some larvae the creamy white of the spiraclar line is centred by a pinkish colour.

5th Instar. April 10, 1952. Length 18 mm. Head pale brown or greenish with dark freckles; body colour has changed from green to black, with a slight bronze reflection, in sharp contrast to the white black-bordered, longitudinal stripes, each of which has a delicate pink flush superimposed upon it.

6th Instar. April 26, 1952. Length 35 mm. Colour and marking as before, but the bronzy reflections more noticeable, and with the surface of the skin with many minute transverse wrinkles. Full fed about May 15. Length 45 mm. tapering a little towards each end. Width 6 mm. in middle of body. One larva burrowed beneath the soil on May 31, but failed to pupate.

Remarks. Of the 20 ova, the majority hatched, but the larvae rapidly died off. Only two finally reached maturity, but without the vitality to

complete the metamorphosis. Possibly the food plant was not the correct one. The eastern form of *N. emmedonia* — the Bronzed Cutworm — is reported as feeding on various cultivated crops. Judging from this and the loosely laid ova, I would have expected the western form to be more catholic in its tastes than has proved to be the case in the present instance.

Moulting was very difficult and prolonged, often lasting for several days; many died before completing the moult and some were not even able to commence it. At no time did the larvae spin a silk thread when moving about or when dislodged from the food plant.

They fed only at night, hiding under the herbage by day, though at no time did I observe them burrowing into the soil except once, evidently for the purpose of pupation. When touched they snap their bodies vigorously from side to side. If alarmed the body is formed into a semicircle with head raised, and held motionless for some time. When at rest along a grass blade, the stripes render them very inconspicuous; they seemed to blend into the grass. One cause for the rapid decline in number, since many disappeared without leaving any sign, may have been due to cannabalism, but no proof of this was discovered. Moulting difficulty appeared to be the cause of most of the casualties.

SCIENCE NOTE

Note on a cat flea population, *Ctenocephalides felis* (Bouché):—On November 6, 1953, I treated a friend's basement for fleas and dusted the pillow on which the cat slept, over a paper, to collect flea eggs. The host cat was quite short-haired and apparently harboured a considerable number of fleas on its body, judging by its energetic scratching. Since the animal was accustomed to sleep by day on several pieces of upholstered furniture in the house which most probably had eggs on them, these were dusted and vacuum cleaned by the owner. The pillow yielded a fair amount of trash, a small amount of dried flea blood, frass and a considerable number of eggs with a very few recently hatched, wriggling larvae. It was all promptly placed in a tightly lidded tin and supplied with powdered fox chow biscuit and a small piece of wetted blotting paper attached to the lid, for moisture. By next day the eggs were hatching freely and the larvae burrowed into the food. The box was kept in a table drawer closed so as to reduce light, at laboratory temperatures, and was examined at intervals.

In four to five weeks the larvae matured and pupated; much of the food powder was used up by sticking to the outside of the silken cocoons which now resembled a bed of rough seeds. Fleas started to emerge and by January 4 all had emerged and died. Their growth was apparently affected by an inadequate supply of flea blood of which not one particle remained in the rearing cage and all the fleas were stunted, males averaging 1.25 to 1.5 mm. and females only slightly larger. There were 902 adults and one dead larva in the box, giving a possible total of 903 fleas by the end of January. If this record is a normal infestation on a short-haired cat, the flea population raised by a long-haired cat or dog must be truly immense.

To separate out the dead fleas, the trash in the box was sifted through three grades of wire mesh. The sifting yielded, besides the fleas, one small hymenopteron, three completely apterous minute mycetophilids and one specimen of the dipterous family phyllomyzidae, genus *Desmomyza*, about two thirds the size of the normal flies in this genus.

The presence of these three other insect species is puzzling unless their pupae had been carried up to the pillow on the cat's feet from the earth around an assortment of plants and bulbs recently dug up and stored for the winter in the basement, over which the cat may have walked. I am not aware of either hymenopterous or dipterous parasites on flea larvae. They were certainly not in the fox-chow biscuit powder supplied to the larvae since this food had been pulverized, sterilized for a week at −40° F. and stored in a tin with a tight lid for a year before being used.— *G. J. Spencer.*

NOTES ON THE LIFE HISTORIES OF EPIRRHOE PLEBECULATA GN. AND EUPHYIA LACTEATA PACK (LEPIDOPTERA: GEOMETRIDAE)

GEORGE A. HARDY

Victoria, B.C.

So far as I can gather there appear to be no records of the food plants or life histories of these two British Columbia moths. The following notes are the results of my investigations concerning them.

Epirrhoe plebeculata Gn. The Orange-winged Carpet. This species is quite common in the Victoria district. Jones (1911) gives its distribution for the province as "Southern B.C." It is on the wing early in the year, being one of the first moths to appear in March and continuing in lessening numbers into May. It may be found flying by day in bright sunshine along woodland borders and forest trails.

An attempt to rear it was made in 1952. Several batches of eggs were obtained from captured females. As the moths were always found in the vicinity of coniferous trees, Douglas fir was tried as a likely food plant, but was refused. A number of other trees, shrubs and herbs was tried, but without avail. All the caterpillars died.

In 1953 another attempt was made. After many trials the larvae took readily to *Galium aparine*, thriving and growing to maturity on it. Several batches of eggs were obtained during the season and reared separately. The number of eggs from individual females varied from one to 50. They were laid indiscriminately on the sides of the box, each separate and independent of the others and affixed by a natural adhesive. The following is a brief chronological account.

Ovum. Laid April 15. Length 0.75mm. x 0.5mm. Elongate oval, slightly flattened, smooth with microscopic reticulations that scarcely appear on the surface, pearly white in colour, becoming yellowish to cream at the time of hatching.

1st Instar. April 25. Length 1 mm. Head light brown speckled with dark brown. Body translucent, later becoming dull bluish-green as food is ingested. A few scattered hairs on each segment. The egg shell is not eaten.

2nd Instar. May 6. Length 5 mm. Head as before. Body pale greenish-grey with whitish dorsal line and lemon intersegmental rings.

3rd Instar. May 10. Length 10 mm. Head as before. Body pale greenish to brown with six fine white longitudinal lines, interrupted at the juncture of each segment by a pale lemon-coloured ring encircling the body. A black dot at the point of insertion of hairs.

4th Instar. May 17. Length 15-16 mm. Head pale beige, spotted with black, sparsely covered with short setae. Body light reddish to greyish brown. Dorsum of thoracic segments with a pronounced longitudinal black line; first five abdominals with a dark brown to black mark on the dorsum, each consisting of an inverted triangular dark brown spot tipped with white; the last four abdominal segments with a strongly marked black line edged with beige colour—a more emphatic repetition of a similar line on the thoracic segments. Underside grey with four white longitudinal lines; a broad dark brown dash in the centre at the juncture of the segments. Spiracular line whitish, marked on the fourth and fifth segments with a thick oblique brown dash. Spiracles black.

The general effect of the above markings is of a small chain terminating at each end with a straightened link and giving to the caterpillar a two-headed appearance, especially as it holds the head extended forward.

At maturity the caterpillar measures 23-25 mm. in length with all markings very pronounced. It feeds at night, hiding at the base of the food plant by day where it lies straight and motionless looking like a twig or dead stalk. At no time was it observed to use silken threads for support or in an emergency such as on a sudden alarm. However, just prior to pupation a few threads were spun to tie together bits of debris or a few grains of sand, as a protection for the pupa.

Pupa. May 30. Pupated about this time, going just beneath the surface soil or getting between leaves or formed into a frail cocoon of bits of loose debris lightly bound together. Length 7 mm. x 3 mm., smooth, shiny; bright mahogany in colour. Cremaster consisting of a two-pronged fork with a very short stem.

Euphyia lacteata Pack.
The March Gem

This is another early day-flying moth, being on the wing from late February to early May. It is to be found in similar habitats to *E. plebeculata.* The moth is quite common around Victoria. Its range in British Columbia, according to Jones' list, is "Southern Vancouver Island, Lower Fraser Valley, Kaslo."

I made the same error as in the study of *E. plebeculata* in supposing the food plant to be a coniferous tree and with the same result. In 1953 renewed efforts were rewarded by finding that the larvae would feed on *Montia perfoliata* and *M. sibirica,* though the succulent nature of these plants gave digestive troubles as the larvae grew older, so that only a few reached the pupal stage.

A pair of adults were taken in coitu on the trunk of *Alnus oregona* on April 8 about 4.30 p.m. From the female 65 fertile ova were obtained. Most of them were laid in a crack in the chip box in which the female was confined; others were scattered indiscriminately over the interior of the box.

From the presence of the moths among alder trees and the deposition of eggs in crevices it was thought that the food plant might be alder; subsequent trials proved this surmise to be incorrect. Only after experimenting with a large variety of trees, shrubs and herbs was it found that *Montia* was the preferred plant genus.

Ovum. Laid April 10. Length 0.75 mm. x 0.5 mm. Oval, slightly larger at one end, smooth with fine microscopic reticulations showing beneath the surface. Colour nearly white becoming lead colour towards hatching time.

1st Instar. April 22. Length 1 mm. Head pale brown, body a translucent watery grey with a few short hairs on each segment. When alarmed the larva rears up on its hind claspers and curls head down, assuming the form of a question mark, and remains motionless in this position until all is quiet again.

2nd Instar. April 29. Length 5-6 mm. Head pale brown, body translucent green; some larvae are reddish in colour.

3rd Instar. May 5. Length 8-10 mm. Head pale brown, body pale green with dark green dorsal stripe due to ingested food; some show faint whitish dorsal and subdorsal lines. Towards the end of this instar the body becomes less translucent and has a grey-green colour with dark dorsal and two thin white subdorsal lines. Spiracles black, intersegmental rings pale.

4th Instar. May 12. Length 15 mm. Head pale brown dotted with light brown flecks. Body jet black with four whitish interrupted lines that take the form of dash-like marks at juncture of the segments.

5th Instar. May 20. Length 23 mm. Head pale brown with small brown dots and an irregular v-shaped brown mark on upper part of head. Body variable in colour as the larvae continue to grow, losing the intense black and pattern of the initial stage of the fourth instar. Dark fuscous to light grey-brown or buff with a broad, black dorsal stripe edged with pale yellow colour, sometimes interrupted on each segment; two thin black lines between the dorsal and the spiracular line. Spiracles black. Underside light grey

with four fuscous longitudinal lines interrupted on each segment by the ground colour, thus giving the appearance of a chain of dashes.

Pupa. Pupation about June 1st. Length 7 mm. x 2.5 mm., dark brown in colour, cremaster consisting of two diverging slightly curved spines. Some of the larvae became sluggish and listless during the close of the last instar, and failed to pupate; only a small percentage of those hatched reached the pupal stage. No cocoon was formed, the larvae merely creeping under debris or between old leaves and pupating after lying quiescent for a day or two.

Remarks. From the ease with which *Epirrhoe plebeculata* fed and thrived, *Galium aparine* is evidently a perfectly satisfactory food plant. At all times the larvae were vigorous and there were no deaths. *Euphyia lacteata*, on the other hand, while readily taking to *Montia* and in fact refusing other plants offered, did not thrive in the final stages, a hint that something was wrong. Possibly the food plant was too succulent, or in nature they changed to some other species of plant. Future investigations may clear the matter up.

Reference

Jones, J. R. J. Llewellyn, 1951. *An Annotated Check List of The Macrolepidoptera of British Columbia*", Ent. Soc. B.C. Occas. Paper No. 1.

STATUSES OF SOME INTRODUCED PARASITES AND THEIR HOSTS IN BRITISH COLUMBIA[1]

J. H. McLEOD[2]

Biological Control Section, Entomology Laboratory, Vancouver, B.C.

From 1949 to 1953 the statuses of the parasites and predators introduced into British Columbia to aid in the control of 11 insect pests were investigated. The methods used were mainly empirical because more accurate methods are not known. The value of a parasite was determined by its ability to provide commercial control over a long period, including intervals of host abundance and scarcity. All biological control projects in British Columbia have been started during periods of host abundance. Species that have reduced the host populations to and maintained them at economic levels for 14 years or more are classed as effective control agents.

This arbitrary method of evaluating parasites has many weaknesses. Commercial control can be achieved at widely different host population levels, *e.g.*, a population up to 10,000 of a lecanium scale or 1,000 of larch sawfly larvae per tree would not be economically important, but 100 codling moth larvae per tree would be.

In this paper, percentage parasitism does *not* indicate the effectiveness of a parasite species, but is used to indicate the relative numbers of the various species that attack the same host or to indicate the numbers of a parasite in relation to those of its host. The numerical relationship between the parasite and host populations necessary for commercial control varies greatly and is dependent upon the effectiveness of other mortality factors.

Apple Mealybug, Phenacoccus aceris (Sign.)

The apple mealybug, *Phenacoccus aceris* (Sign.), was discovered in British Columbia in 1913 and by 1935 was causing serious inconvenience to the fruit growers in the Kootenay Valley. The excretion from the insects promoted the growth of a sooty fungus that rendered the fruit unsalable unless washed.

From 1938 to 1943 colonies of *Allotropa utilis* Mues. totalling 6,602 adults

[1] Contribution No. 3165, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.

[2] Agricultural Research Officer.

were released at 11 selected points throughout the infested area. By 1943 this parasite had become well established. In 1944 and 1945, four colonies comprising 4,549 individuals obtained at the original release points were released in the Kootenay Valley. In 1948 a colony of 133 adults was released in a small area of infestation near Royal Oak on Vancouver Island.

The apple mealybug has been controlled by *A. utilis* in the Kootenay Valley since 1943 and on Vancouver Island since 1949. An important factor in the effectiveness of *A. utilis* is its ability to survive sprays of dormant oil lime-sulphur whereas many of the apple mealybugs are killed by this treatment. When the spray is applied, *A. utilis* is in the pupal stage and is protected by the mummified remains of the host, in which it pupates.

Marshall (1953) stated that *A. utilis* must be one of the outstanding examples in Canada of biological control by an introduced parasite.

Codling Moth, Carpocapsa pomonella (L.)

The codling moth, *Carpocapsa pomonella* (L.), was first reported on Vancouver Island in 1900 and in the interior of British Columbia in 1905. The menace of this pest to the fruit industry was recognized at an early date and rigorous eradication regulations are credited by Marshall (1952) with preventing serious losses until the regulations were relaxed in 1925. During the next 20 years the codling moth increased in destructiveness. Since 1945 the use of DDT and the development of more efficient spray equipment have controlled the codling moth in commercial orchards (Marshall, 1953). The general use of DDT is believed to be responsible for the rapid increase in orchard mite populations and for this reason substitute insecticides are being sought.

Biological control of the codling moth was attempted through the introduction of three species of parasites: *Ascogaster quadridentata* Wesm., *Ephialtes caudatus* (Ratz.), and *Cryptus sexanulatus* Grav. Stock of *A. quadridentata* was obtained in Ontario and propagated at the Entomology Laboratory, Belleville, Ontario. A total of 50,800, in colonies of 291 to 33,250 individuals, were released at various points throughout the Okanagan Valley in 1934, 1935, 1936, 1937, and 1939. *A. quadridentata* became established but its numbers have not yet increased sufficiently to affect the codling moth population.

Small numbers of *E. caudatus* and *C. sexannulatus* were imported from France and both species were propagated at the Belleville laboratory. Colonies of 54 and 4,199 adults of *E. caudatus* were released in the Okanagan Valley in 1942 and 1946, respectively. Colonies totalling 3,030 of *C. sexannulatus* were released at six points in the interior of British Columbia in 1941, 1946, and 1947. Neither species has been recovered. The search for effective parasites of the codling moth is continuing.

European Earwig, Forficula auricularia L.

The European earwig, *Forficula auricularia* L., was first reported from British Columbia in 1916. In 1929 Buckell reported that on the Pacific coast the European earwig had become firmly established and was a serious garden and household pest.

Small colonies of *Bigonicheta setipennis* (Fall.) obtained from England and released at New Westminster between 1928 and 1931 did not give evidence of becoming established. In 1933 breeding stock of this parasite was obtained from the City of Portland, Oregon. More than a quarter of a million parasites were propagated at the Divisional laboratory at Victoria and were released at selected points from 1934 to 1939.

B. setipennis became established and in 1945 seventy per cent. parasitism was recorded in Vancouver by Spencer (1947). In 1951, the range of parasitism at seven widely separated points on Vancouver Island was from 10.9 to 50.0 per cent.; at 10 on the mainland, from 1.6 to 30.4 per cent. Further data on the parasitism in the Vancouver area were obtained when

mass collections of the earwigs were reared to obtain *B. setipennis* for transfer to other infested areas in Canada. The numbers of *B. setipennis* and of *F. auricularia* and the percentage parasitism for collections made in 1950, 1951, and 1952 were respectively: 6,211, 52,500, and 11.8; 8,097, 42,800, and 18.9; 7,669, 71,300, and 10.8.

B. setipennis is the only parasite that has been reared from the European earwig in British Columbia and is a more important control factor than predators or disease. One of the most important predators is a carabid, *Feronia melanaria* Ill. Spiders have been observed feeding on the earwig. The common house spider, *Parasteatoda tepidariorum* (C. L. Koch), is an efficient predator of arboreal earwigs.

B. setipennis puparia are parasitized by a pteromalid, *Dibrachys* sp. *Dibrachys cavus* Wlkr. was reported by Thompson (1943) as a parasite of *B. setipennis* in England; but Dr. O. Peck, Entomology Division, Ottawa, who examined specimens reared from *B. setipennis* in British Columbia, reported (in litt.) that these secondaries through *B. setipennis* are distant from *D. cavus* and presumably of a new species.

B. setipennis is not numerous enough to control the earwig, but with other control agents it has prevented the earwig from becoming a major insect pest in British Columbia.

Lecanium Scales

The identities of lecanium scales in British Columbia are obscure. It is believed that there is a mixed population of two or more species, including the European fruit lecanium, *Lecanium corni* Bouché, and the hazel nut scale, *L. coryli* (L.), both of which were introduced accidentally from Europe. Glendenning (1933) stated that since 1925 the lecanium scale had been one of the most destructive insects in the coast region of British Columbia. A colony of 263 adults of *Blastothrix sericea* (Dalm.), obtained from England, was released in 1928; and two colonies totalling 779 adults were released in 1929. Glendenning (loc. cit.) reported that the colonies of *B. sericea* released in 1928 and 1929 became established and by 1932 had spread over the entire area of infestation, which at that time was 200 square miles. The number of scales per foot of twig was reduced from an average of 35 in 1930 to a maximum of two in 1932. The parasitism of the few adult scales present in 1932 ranged from 90 to 100 per cent. Lecanium scales have not since been of economic importance in British Columbia.

Clausen (1951) proposed the theory that a "fully" effective parasite would achieve control at the colonization points within three host generations or within three years after the parasites are released. He assumed that certain requirements had been met, and included in the list "that releases were synchronized with the time of abundance of the preferred host stages." The colonies of *B. sericea* that were introduced into British Columbia were released from June 24 to July 27, when the host is in the egg or early "crawler" stage and is not suitable for parasitism. Graham and Prebble (1953) stated that in southwestern British Columbia the first-generation eggs of *B. sericea* were never found in the nymphal scales earlier than September 18, although adults of *B. sericea* emerged from the fully formed female scales in the latter half of June, and the young scale crawlers were on the foliage from early June onwards; there was thus an interval of more than two months when the parasite was apparently not associated with the scale. Investigations by the author in 1952 and 1953 confirmed these findings. It was also found that *B. sericea* females of the summer generation do not become sexually mature until shortly before oviposition occurs, in late September. This is an example, therefore, of an introduced parasite having controlled a host within three years although its release was not synchronized with the time of abundance of the preferred host stage.

The simultaneous increase in the population of *B. sericea* and decrease in that of *L. coryli* reached its climax in 1931 and was followed by a long period of low host population. During their

investigation, from 1941 to 1945, Graham and Prebble (loc. cit.) found that although the *L. coryli* infestation had remained at a low level it had spread about 70 miles eastward on both sides of the Fraser River. It had also spread westward to Vancouver Island, where it was well established in the Victoria district. By 1951 it had spread northward on Vancouver Island to the Saanish Peninsula. *B. sericea* has followed its host to all the new areas of infestation.

Spiders in the field and European earwigs in the laboratory have been observed feeding on *L. corni*, but predators are not believed to be an important control factor. A few specimens of a native parasite, *Aphycus* sp. near *kincaidi* Timb., have been obtained from several thousand scales reared in the laboratory. No secondary parasites of *B. sericea* have been reared. Although recent investigations have shown that there is seldom more than 40 per cent parasitism of the overwintering scale population, this additional mortality factor is probably responsible for the continued low level of the lecanium scale population in British Columbia.

Greenhouse Whitefly, Trialeurodes vaporariorum (Westw.)

The greenhouse whitefly, *Trialeurodes vaporariorum* (Westw.), has been a pest of many greenhouse crops since it was first reported in British Columbia in 1907. With the development of more efficient and economical fumigation material and equipment, many growers have been able to control the whitefly without serious difficulty. Other growers, whose greenhouses are unsuitable for effective fumigation or who produce crops that are easily injured by fumigants, have used the parasite *Encarsia formosa* Gahan extensively.

In British Columbia *E. formosa* was first used successfully in greenhouses in 1934; and for 20 years from 100,000 to 475,000 of these parasites, propagated at the Belleville, Ontario, laboratory, have been shipped annually on request to greenhouses and conservatories in British Columbia. It is necessary to recolonize *E. formosa* each year because of the methods of handling greenhouse-grown crops.

Improved methods of propagating and shipping *E. formosa* have been developed and the optimum number of the parasites required for satisfactory control may be calculated from the size of greenhouse, the crops grown, the degree of infestation, and the temperature at which the greenhouse is maintained (McLeod, 1936).

Holly Leaf Miner, Phytomyza ilicis (Curt.)

The holly leaf miner, *Phytomyza ilicis* (Curt.), was accidentally introduced into British Columbia with imported nursery stock, and by 1931 it was causing considerable injury and was widely distributed over the holly-growing area (Downes, 1931).

Five species of parasites were imported from England and colonies were released on Vancouver Island from 1936 to 1938 and on the mainland in 1939 as follows:—

	Vancouver Island	Mainland
Chrysocharis gemma (Wlkr.)	34,564	11,393
Chrysocharis syma Wlkr.	1,978	179
Cyrtogaster vulgaris Wlkr.	2,227	471
Opius ilicis Nixon	33	10
Sphegigaster flavicornis Wlkr.	6,359	852

On Vancouver Island the first recoveries were obtained in 1940 (Downes and Andison, 1941). *C. gemma* was obtained in large numbers at one of the release points and "a survey of the plantation revealed the fact that approximately 80 per cent of all *Phytomyza* mines were parasitized." *O. ilicis* was also established in 1940, although no recoveries had been obtained in 1938 from the caged tree on which 33 individuals were released in 1937.

From 1949 to 1953, collections from Vancouver Island and the mainland yielded specimens of all species that had been released except *C. syma*, but *C. gemma* was recovered only on Vancouver Island and *C. vulgaris* only on the mainland. The percentage parasitism from these collections was not so high as that reported by Downes and Andison (loc. cit.), the highest being 60 and the average about 30

on both Vancouver Island and the mainland. On Vancouver Island *C. gemma* was responsible for more than 90 per cent of the parasitism and on the mainland *O. ilicis* was responsible for 80 to 90 per cent. *S. flavicornis*, although present in both areas, was of minor importance.

It is remarkable that *O. ilicis* attained its present status on the mainland as the original colony consisted of only four males and six females. This species is a relatively unimportant parasite of the holly leaf miner in England; Cameron (1939) stated that it was a rare species and that only 0.3 per cent of the mines were attacked by it.

No native parasites were reared from the holly leaf miner during this investigation; but several specimens of *C. vulgaris* were reared from a native species of grass leaf miner, *Phytompza nigra* Mg., which has apparently been adopted as an alternate host.

The usefulness of these parasite species is difficult to evaluate. The holly bud moth, the strawberry root weevil, and the black vine weevil often require chemical treatment for their control in commercial holly plantations, and these treatments also control the holly leaf miner. However, there are thousands of holly trees in ornamental plantings in the area and few of these receive chemical treatment. The introduced parasites undoubtedly contribute materially to the control of the holly leaf miner in such plantings.

Larch Sawfly, Pristiphora erichsonii (Htg.)

In British Columbia the larch sawfly, *Pristiphora erichsonii* (Htg.), was first reported in 1930 (Hopping, Leech, and Morgan, 1943). In 1933 cocoon samples were obtained and no evidence of parasitism was found. Colonies of parasites were introduced in 1934, 1935, 1936, 1941, and 1942. The larch sawfly infestation started near Fernie, in the southeastern part of the province, and spread westward. The parasite releases in 1941 and 1942 were made on the western fringe of the infestation to hasten establishment of the parasites over the entire area of infestation.

Three species of parasites were released as follows:—*Bessa harveyi* Tns. (=*selecta* Mg. of American authors): 1942, 5,995; *Mesoleius tenthredinis* Morley: 1934, 673; 1935, 2,196; 1936, 781; 1941, 624; 1942, 702; *Zenillia* nox Hall.: 1935, 1,265.

M. tenthredinis became established and increased rapidly. *B. harveyi* became established, but has not increased enough to be of economic importance. *Z. nox* has not been recovered.

Tritneptis klugii (Ratz.), a European species that was not released, has also become established. This species may have spread into British Columbia from contiguous areas of larch sawfly infestation in Montana. The usefulness of *T. klugii* is doubtful because it oviposits in larch sawfly cocoons indiscriminately and destroys many of the host larvae that have already been parasitized by *M. tenthredinis*.

Specimens of *Endasys* (*Endasys*) sp. and *Euceros* sp. have been reared from mass collections of larch sawfly cocoons. Both are hyperparasites of *M. tenthredinis*, but neither species is abundant enough to be of economic importance.

At no time since it became established in British Columbia has the larch sawfly reached outbreak proportions except in small, isolated areas. The population in each of the heavily infested areas for which there are records became heavily parasitized by *M. tenthredinis* and subsided without serious injury to the trees.

From 1948 to 1951 samples of larch sawfly cocoons were obtained from a localized infestation and were dissected to determine the degree of parasitism and mortality. The results (Table I) showed that a large part of the mortality during this period was due to parasitism by *M. tenthredinis*. In 1952 and 1953 the larch sawfly population had dropped to such a low level that it was impractical to collect cocoons to determine the degree of parasitism.

TABLE I

Mortalities and parasitism of larch sawfly larvae in cocoons in British Columbia, 1948 to 1951

Condition of Larvae	1948		1949		1950		1951	
	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.
Cocoons dissected	1,500	100	536	100	441	100	1,200	100
Dead	248	16.5	40	7.5	53	12.0	102	8.4
Parasitized by *M. tenthredinis*	829	66.2*	305	61.5*	213	54.9*	747	68.0*
Parasitized by *T. klugii*	10	.8*	23	4.6*	5	1.3*	7	.7*
Living	413	27.5	168	31.3	170	38.5	344	28.7

* Based on number of living larch sawfly larvae.

Oystershell Scale, Lepidosaphes ulmi (L.)

The oystershell scale, *Lepidosaphes ulmi* (L.), has been a pest of fruit and other deciduous trees in British Columbia for at least 50 years. In 1914 Treherne included it among the more important pests of the lower Fraser Valley. The oystershell scale is not now an important pest in commercial orchards, as it is kept under control by the regular spray schedule for other pests. However, commercial orchards are continually subject to reinfestation from infested wild host plants.

The introduction of the predacious mite *Hemisarcoptes malus* (Shimer) in 1917 marked the first attempt in Britissh Columbia to control insect pests through their natural enemies. Colonies totalling approximately 1,000 of *H. malus* were released at one point on Vancouver Island, two points in the Fraser Valley, and one point in the Okanagan Valley. Glendenning (1931) reported that at Agassiz and Vernon the mite survived, and under certain conditions effected excellent control.

Recent investigations by the author have shown that *H. malus* is now widely distributed in British Columbia. The population of this species was greatly reduced during the winter of 1949-50, when the temperature dropped below −30° F. at many points in the interior of the province. It is known, however, that *H. malus* has at times been an important control factor.

Pea Moth, Laspeyresia nigricana Steph.

The pea moth, *Laspeyresia nigricana* Steph., was first reported from British Columbia in 1933. It soon became a serious pest in the Fraser Valley, where most of the canning peas in British Columbia are grown. Wishart (1947) stated that from 1934 until 1945 it increased steadily on Sumas Prairie and in 1945 eighty per cent of the pods were infested.

Four species of parasites were imported from England and colonies were released from 1937 to 1939 as follows: *Ascogaster quadridentata* Wesm., 5,291; *Glypta haesitator* Grav., 1,543; *Horogenes* spp., 35; *Pristomerus vulnerator* (Panz.), 5. *A. quadridentata* and *G. haesitator* became established and the numbers increased rapidly. The percentage parasitism was reported for the release area by Wishart (loc. cit.) for 1941, 1942, 1943, 1944, and 1945 as follows: *A. quadridentata*, 0.34, 1.24, 7.59, 10.80, and 76.39; *G. haesitator*, 0.14, 1.87, 0.70, 3.00, and 3.74; total parasitism, 0.48, 3.11, 8.29, 13.80, and 80.13. *Horogenes* spp. and *P. vulnerator* have not been recovered.

In 1946 the pea moth infestation dropped from 80 to 35 per cent in the parasite release area. In that year an important change occurred in pea-growing practices in the area. The growing of dried peas was discontinued and only canning peas were grown commercially. When dried peas are produced, the crop is not harvested

until after the pea moth larvae have left the infested pods and entered the soil to pupate. When canning peas are produced, the crop is harvested before the pea moth larvae have completed their development and many of them are destroyed. The 45 per cent reduction in infestation that occurred in 1946, however, could not have been caused exclusively by this change in cultural practice, for an infestation of 76 per cent was recorded in areas where the parasites had not yet become established.

Between 1947 and 1953 the population of the pea moth remained at an extremely low level in cultivated peas. In 1949, of 8,921 pods examined, 196 were infested; in 1950, 1951, 1952, and 1953 the infestation was less than one per cent.

Yet there was a relatively large population infesting wild host plants, the most favoured of which is a species of vetch, *Vicia angustifolia* L. Larvae in these plants were heavily parasitized by the introduced parasites. In 1951, 61.6 per cent .of the larvae were parasitized, 45.1 per cent by *A. quadridentata,* 13.8 per cent by *G. haesitator,* and 2.7 per cent by undetermined Hymenoptera.

The low population of recent years is probably due in part to the abandonment of the production of dried peas. The introduced parasites *A. quadridentata* and *G. haesitator* are, however, an important contributing factor. There are many thousands of home gardens in the infestation area. In most gardens peas are grown and some are left to ripen. Although home gardens and wild host plants are potential sources of infestation, infestations in cultivated peas have been extremely light and chemical control has been unnecessary. The high percentage parasitism in the wild host plants is probably the most important factor in the continued low population of the pest.

Satin Moth, Stilpnotia salicis (L.)

The satin moth, *Stilpnotia salicis* (L.), was first reported from British Columbia in 1920. The infestation developed to serious proportions in the willow and cottonwood stands of the lower Fraser Valley (Glendenning, 1931). Four species of parasites were introduced from New Brunswick and Massachusetts between 1929 and 1934 as follows: *Apanteles solitarius* (Ratz.), 1933, 737; *Compsilura concinnata* (Mg.), 1929 to 1934, 3,592; *Eupteromalus nidulans* (Thoms.), 1933, 4,313; *Meteorus versicolor* (Wesm.), 1934, 520.

All species except *E. nidulans* became established and *A. solitarius* increased and spread rapidly. The infestation of the satin moth abated and no widespread outbreak has occurred since 1934. In 1951 there was a light infestation on two willow trees on the University of British Columbia campus. From 259 satin moth larvae collected from these trees, 50 adults of *C. concinnata,* 102 of *M. versicolor,* and 14 of *A. solitarius* were obtained, the combined parasitism was 64.1 per cent.

The three species of introduced parasites were parasitized by native secondary parasites. *Dibrachys cavus* Wlkr. parasitized all three species and *Gelis tenellus* (Say) parasitized *M. versicolor.* However, these secondary parasites were not abundant enough to seriously affect the primary parasites. Although no species of native primary parasites have been reared from the satin moth during the present investigations, Glendenning (1932) reported having reared five species of Diptera and three of Hymenoptera from larvae and pupae. He stated that none of these native parasites had been noticed in recent years and they could not be relied upon to check this pest to any appreciable extent. The introduced parasites have survived through an extended period of low host population and continue to be effective control agents.

Woolly Apple Aphid, Eriosoma lanigerum (Hausm.)

The date when the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), became established in British Columbia is not known, but in 1914 Treherne included it in a list of economically important insects in the lower Fraser Valley. *Aphelinus mali* (Hald.) is the most important parasite of the aphid

and has been introduced into most of the countries where the latter occurs.

A. mali was introduced from Ontario to the lower Fraser Valley in 1921 and to the Okanagan Valley in 1929. Reports on the introduction, establishment, and distribution of *A. mali* in the Okanagan Valley were given by Venables (1931, 1937).

The past and present statuses of both the woolly apple aphid and its parasite *A. mali* have been succinctly stated (in litt.) by Dr. J. Marshall, Officer-in-charge, Entomology Laboratory, Summerland, B.C., as follows: "Twenty-five years ago the woolly apple aphid was the most troublesome pest of the British Columbia apple industry. It malformed the trees, smutted the fruits, and made picking highly unpleasant, and, most important, its feeding was associated with the development of the serious fungus disease, perennial canker. The fungal organism develops only in tissue that has been fed upon by woolly aphids. With the equipment of the time, chemical control of the aphid was unsatisfactory. Consequently, work was begun to establish biological control, and it was accomplished within a few years by introduction of the parasite *Aphelinus mali,* which was introduced into the province through the Entomology Laboratory, Belleville, Ontario. The aphid became a minor pest and remained so until DDT was generally used for codling moth control, in 1945. As DDT proved innocuous to the aphid but toxic to the parasite, once again the aphid is a major pest. Investigations are to be undertaken to re-establish the effectiveness of the parasite either by substituting for DDT in the apple spray schedule a chemical non-toxic to the parasite, or by developing a DDT-resistant strain of the parasite."

Discussion

Introduced parasites achieved commercial control for 14 years or more of five pest species, *i.e.*, the apple mealybug, the larch sawfly, lecanium scales, the pea moth, and the satin moth. A sixth insect pest, the woolly apple aphid, was controlled for at least 10 years, until DDT was used for the control of the codling moth.

The times required for the parasites of these six insect pests to give evidence of commercial control conformed, with one exception, with Clausen's (loc. cit.) conclusion that a "fully" effective parasite or predator will achieve control near the colonization points within three host generations or three years after release. The one pest that was not brought under control within three years was the pea moth; *A. quadridentata* has continued to be the most abundant parasite species since it became established, but it did not become an effective control agent until six years after the last colony was released.

Three of the insect pests investigated were controlled only in some areas and in some years, *i.e.*, the oystershell scale, the European earwig, and the holly leaf miner. The degree of control that has resulted from the establishment of the parasites and predators of these pests is difficult to assess. There has not been an important outbreak of any of the pests mentioned since the establishment of their natural enemies in British Columbia.

The parasites of the codling moth have been ineffective. Two species did not become established; the third became established, but though widely distributed, is ineffective. The requirements for commercial control of the codling moth are so rigid as to entail practical elimination of the pest. It is doubtful whether a biological control agent can be found that will by itself achieve such a degree of control. However, a new combination of chemical and biological control for the codling moth may solve the present extremely complex problem of orchard mite control, presumably brought about through the use of DDT and the absence of effective biological agents to control the codling moth.

E. formosa, the parasite of the greenhouse whitefly, is effective under suitable temperature conditions, but because of the methods employed in handling greenhouse-grown crops it is

necessary to recolonize the parasites at frequent intervals.

The insect pests that have been discussed are all introduced species. There is no evidence that any native parasite attacks any of these pests in appreciable numbers. There are two species of exotic parasites and one exotic predator that are relatively important. *T. klugii* has become established as a parasite of the larch sawfly, but it also destroys large numbers of the effective introduced parasite *M. tenthredinis*. *A. mytilaspidis* is a widely distributed parasite of the oystershell scale, but the population is not large enough to provide control. The carabid beetle *F. melanaria* is a predator of the European earwig but is not abundant enough to be effective.

A few indigenous species of secondary parasites are known to parasitize some of the introduced parasites, but none are economically important except possibly *Dibrachys* sp. This species may at times be an important secondary parasite of the European earwig through *B. setipennis*.

References

Buckell, E. R. 1929. The Dermaptera of Canada. Proc. Ent. Soc. B.C. 26: 9-27.

Cameron, E. 1939. The holly leaf miner (*Phytomyza ilicis*, Curt.) and its parasites. Bull. Ent. Res. 30: 173-208.

Clausen, C. P. 1951. The time factor in biological control. J. Econ. Ent. 44: 1-9.

Downes, W., 1931. Holly insects. Proc. Ent. Soc. B.C. 28: 25-28.

Downes, W. and H. Andison. 1941. The establishment in British Columbia of parasites of the holly leaf miner, *Phytomyza ilicis* Curtis. J. Econ. Ent. 33: 948.

Glendenning, R. 1931. The progress of parasite introduction in British Columbia. Proc. Ent. Soc. B.C. 28: 29-32.

Glendenning, R. 1932. The satin moth in British Columbia. Canada Dept. Agr., Pam. 50 (new ser.). 3rd revised ed.

Glendenning, R. 1933. A successful parasite introduction into British Columbia. Canadian Ent. 65: 169-171.

Graham, K., and M. L. Prebble. 1953. Studies of the lecanium scale, *Eulecanium coryli* (L.) and its parasite, *Blastothrix sericea* (Dalm.), in British Columbia. Canadian Ent. 85: 153-181.

Hopping, G. R., H. B. Leech, and C. V. G. Morgan. 1943. The larch sawfly, *Pristiphora erichsonii* (Hartig), in British Columbia with special reference to the cocoon parasites *Mesoleius tenthredinis* Morley and *Tritneptis klugii* (Ratzeburg). Sci. Agri. 24: 53-63.

Marshall, J. 1952. Applied entomology in the orchards of British Columbia, 1900-1951. Proc. Ent. Soc. B.C. 48: 25-31.

Marshall, J. 1953. A decade of pest control in British Columbia orchards. Proc. Ent. Soc. B.C. 49: 7-11.

McLeod, J. H. 1938. The control of the greenhouse whitefly in Canada by the parasite *Encarsia formosa* Gahan. Sci. Agr. 18: 529-535.

Spencer, G. J. 1947. The 1945 status of *Digonochaeta setipennis*, tachinid parasite of the European earwing, *Forficula auricularia*, Linn., in West Point Grey, Vancouver, B.C. Proc. Ent. Soc. B.C. 43: 8-9.

Thompson, W. R. 1943. A catalogue of the parasites and predators of insect pests. Section 1, Parasite host catalogue. Part 2, Parasites of the Dermaptera and Diptera. Imperial Institute of Entomology, Parasite Service, Belleville, Canada. (processed)

Treherne, R. C. 1914. Insects economically important in the lower Fraser Valley. Proc. Ent. Soc. B.C. 4: 19-33.

Venables, E. P. 1931. *Aphelinus mali* Hald., a parasite of the woolly aphis. Proc. Ent. Soc. B.C. 28: 16-20.

Venables, E. P. 1937. Further notes on the woolly aphis parasite *Aphelinus mali* Hald. Proc. Ent. Soc. B.C. 34: 33-35.

Wishart, Geo. 1947. Important reduction of three introduced pests in British Columbia by introduced parasites. 77th Ann. Rept. Ent. Soc. Ontario, 1946, pp. 35-37.

FOREST INSECT SURVEYS

H. A. RICHMOND*
Laboratory of Forest Biology, Victoria, B.C.

Probably no single phase of entomological activities offers a wider field for variety in object and methods than surveys, for each survey must vary according to its size, purpose, and the circumstances governing it. This paper deals in general with the Forest Insect Survey in which we are presently engaged in Canada and specifically with its operation in British Columbia.

The Forest Insect Survey in Canada had its inception in 1935 when an organized attempt was made to keep an annual check on the spread and distribution of the European spruce sawfly in Eastern Canada. Since that time the survey has expanded in size and purpose and today it operates from Newfoundland to British Columbia. No longer restricted to the recording of species distribution and insect outbreaks, it now includes within its function general ecological consideration of our forest insect populations. In brief, its objects may be outlined as follows: to report annually on the fluctuations of insect populations encountered in the forest on a scale sufficiently broad to be representative of the entire forest area; to amass records as complete as possible on parasites and their hosts; to follow the course of disease of insects, particularly of those species known to be our more important forest destroyers; to locate incipient outbreaks as early as possible; to locate and, if possible, control any newly arrived foreign pest before serious damage or dispersal has occurred; to provide information on life histories, habits and identification of immature forms and to gather such specialized data as may be vital to some specific research undertaking. Within the last year the survey has expanded to include the procuring of data relative to certain specific tree diseases.

In its immediate application the survey provides information on the current status of forest insects over specific areas, permitting those concerned to take such action as may be expedient to prevent or reduce possible losses. On a long-term basis the survey provides much important data for specialized projects and points up many problems requiring intensive study. It is therefore as much a tool to the service as it is an end in itself.

In the operation of a continent-wide survey, methods and procedures must fit local conditions and hence no one standard method can be applied. In the beginning the survey was primarily qualitative in nature. The general method of sampling the insect population on a tree was to spread a sheet of standard size on the ground below the tree and to strike the limbs above with a pole of standard length. Dislodged larvae fell to the sheet, were collected, placed in a mailing container with food and a completed enclosure slip, and mailed to a regional laboratory for identification and rearing. Data from such collections were quantitative only in a very gross way. Although referred to as the earliest method of sampling, it is still used quite widely in random sampling for defoliators over extensive and remote regions. As the value and application of survey data became evident, new and specialized sampling methods were developed to meet peculiar requirements and situations. In many areas, sampling is now being done on permanent sample plots selected as representative of the forest stand of the region. Sampling from the same plot may be done three or four times a season. The use of plots has been developed on a rather restricted basis pending a thorough appraisal of the relative merits of random observations in contrast with similar data derived from representative plots. Work of this nature is possible only in areas readily accessible, free from cutting and with assurance of a degree of permanency. Another sampling method has been the cutting of measured branches or twig samples and recording the number of larvae present. Collecting moss for egg counts

* Officer-in-charge, Forest Insect Laboratory, Division of Forest Biology, Canada Department of Agriculture, 409 Federal Building, Victoria, B.C.

and sampling of the forest floor for hibernating insects are other special methods employed.

Probably the greatest difficulty in sampling for defoliators on the west coast is the size and height of trees and the impossibility of reaching up the bole even a short distance. In an effort to cope with this problem, research of recent years suggests the practical application of the collection and measurement of frass fall from the feeding population. In this procedure, portable canvas trays are established below representative trees in the area concerned and through the accumulation of frass over a definite period correlated with the increase in body weight of the larvae in the same period, an index of the feeding population is obtained.

Although the survey is still in its early development we have learned much from it, but no doubt its greatest value will be evident in the future as more data are amassed. Illustrative of this is the relationship of one species of insect to another in the chronological sequence in their cyclic recurrence. There is reason to believe that during the general population increase of defoliators in the west, the build-up of the various species may follow a fairly definite pattern. In other words the increase of a certain species may presage the later rise in population of another and perhaps more important species. If and when increased knowledge permits an accurate prediction of events before they happen we will have passed an important milestone on the way toward coping with our forest insect problems.

With the extension of random surveys, however, a point of diminishing return is eventually reached when successively less new information is obtained for equal expenditure of effort. More and more attention is now being directed to selected problems to provide more critical information on population trends, control factors, and damage caused by infestations. In the West, such work has centred about the western hemlock looper and bark beetles.

Since major outbreaks such as the hemlock looper occur at intervals of 12 or 15 years, opportunities are infrequent for the study of events in the insect complex that lead up to such outbreaks. We are, in fact, only beginning to accumulate data relative to such phenomena. The early records of insect outbreaks were for the most part very general in nature, concerned only with the species responsible for the damage and restricted to the one or two years when the insect was most prevalent. While probably quite adequate at that time, these early records give little historical or scientific background information with respect to the rise and fall of the outbreak. The inclusion of data on the associated species of no apparent importance was obviously impossible with the limited personnel employed in the early days of entomology in this country.

The survey in which we are engaged places equal emphasis on insects whether they be of minor or major importance economically. Knowledge of these so-called minor associates may eventually supply the key to long term predictions of population trends of other pests: to an understanding of the survival of parasites during periods of low population of its preferred host, or the zoning of the forest for possible distribution of certain major pests. One might speculate at great length on future possibilities of such work. Since important outbreaks recur but a few times in the life of any worker, few workers today will live to realize the full significance or value of such surveys. Our successors will benefit from the fuller, deeper understanding that must accrue from long-term, intense surveys.

With this general review of the survey, mention should now be made of something of the mechanics of its operation. The sampling of insects, the establishment of plots, mapping, reporting and the many phases of work in the field are handled by a specially trained non-technical staff of insect rangers. An important requirement in field work is familiarity of the particular region concerned, the

forests of that area, personnel engaged by either the Forest Service or industry, methods of travel, etc. Permanence of staff is therefore essential to give continuity from year to year and to produce maximum efficiency. For these and other reasons a ranger staff as mentioned is considered best. Rangers are chosen with great care since it is exacting work requiring a man of very special temperament. There are nineteen rangers employed in British Columbia.

The British Columbia coast does not lend itself to easy survey methods due to the almost total lack of roads. With approximately 7,000 miles of shore line, many parts cannot be reached more frequently than once in two years. It has become evident to many of the larger operators that regular sampling can be achieved only if their personnel in that area assist. Arrangements have been made in several regions whereby the companies concerned conduct periodic sampling throughout the year on plots originally established in co-operation with the Forest Insect Laboratory.

Associated with the field staff of rangers is the professional staff at the laboratory who receive, identify, and rear the living larvae through to the completion of their life cycle from which final records are compiled. Specialized rearings and studies of certain specific groups of insects are undertaken by the laboratory personnel for life-history studies, parasite and disease work, taxonomic data or other related problems.

Directing all survey activities both in the field and in the laboratory is the survey head for the province. He must be a combined forester, entomologist, and ecologist. Through him the work of the ranger staff is organized on a sound scientific basis. Current reports are analyzed for their significance and the work of the survey is co-ordinated with the research staff. Thus the survey not only supplies information on abundance, distribution, etc., but it also yields valuable data for those undertaking special research investigations.

In order to achieve continuity throughout the service, to promote a maximum of efficiency, and to unify procedures and methods, the Canada-wide survey is headed by a divisional survey co-ordinator. The over-all efficient operation of the survey and the development of specialists needed in its operation at the various centres are his responsibilities.

During a typical year the survey in British Columbia handles some 25,000 individual rearings which, in turn, entail a similar number of separate rearing sheets, each record containing the pertinent insectary and field data. A periodic analysis of so large a volume of records, if done manually, would be impossible without a greatly expanded staff. To cope with this a standard punch-card system of recording was established across Canada in 1952.

Henceforth all information, including the identity of the insect, will be coded and punched on the cards. The mechanical sorter can handle 400 cards per minute, sorting for as many as 12 columns simultaneously. Hence it will be possible to draw out information as required with a minimum of effort and time for as many years as one may wish. The installation of this equipment in all main survey centres across Canada and the development of a standard punch card and field record sheet constitute an important step in rounding out an adequate forest insect survey, for unless the information is readily usable its recording would seem futile at the outset.

Almost synonymous with surveys is the problem of population sampling. The development of surveys in Canada and the United States and the application of these data to specific problems and research projects call first for a study of the basic problem of population sampling. Obviously it will be many years before techniques of known value capable of being used by non-specialists can be developed for each important insect. In the meantime methods purely empirical in nature must be employed which in many cases are of doubtful significance. As qualified investigators develop the field of sampling techniques so may we expect advancement in the field of insect surveys.

NOTES ON THE LIFE HISTORY OF CORYPHISTA MEADI PACK. AND FORM BADIARIA HY. EDW. (LEPIDOPTERA: GEOMETRIDAE)

GEORGE A. HARDY

Victoria, B.C.

The following notes on the life history of the moth *Coryphista meadi* Pack. may be of interest as bearing on the relationship of the colour forms. A female of the form *badiaria* was taken on Mount Prevost on May 20, 1952. From this specimen a batch of ova was obtained and the resulting larvae were reared to maturity.

Ova. Laid in small box on May 20-23 inclusive, singly or in short strings in which the ova were laid side by side, until a total of 75 was obtained. Shape oblong, smooth with minute reticulations. Size 0.75 mm. x 0.50 mm. Colour creamy, becoming darker towards hatching time.

1st Instar. Hatched May 27. Length 2 mm. Head light brown; body colourless, translucent, soon becoming green after feeding. No markings. The larva does not eat the egg shell. The food plant is *Berberis nervosa;* other plants, placed before it were refused. When jolted the larva hangs by a silk thread to the twig or leaf from which it has fallen. When mildly disturbed it draws the body into a tight vertical loop, claspers and true legs touching. In this position it remains motionless for some time, or until all is quiet again.

2nd Instar. June 1st. Length 10 mm. Head pale brown; body dark green to black with white interrupted spiracular line Feeds at first on underside of leaf, chewing through the epidermis on one side only. Later it feeds at edge of leaf in the usual manner.

3rd Instar. June 6th. Length 14 mm. Head as before; body black with a broad irregular spiracular line and four thin longitudinal lines on the back, all white. Underside dark olive green.

4th Instar. June 10th. Length 18 mm. Head orange; body as before but with intensification of the black and white; spiracular line very conspicuous and with a chain-like formation due to a series of interrupted black hyphen-like marks along the centre of the line, placed at the junction of two segments. The wider part of the line is suffused with pale lemon yellow, and contains two black tubercles. The spiracles are black and are centred on the spiracular line, giving to the segments containing them the appearance of three black dots. Underside fuscous with a medium white line. When full fed the larva measures 25 mm; it is then a strikingly handsome caterpillar.

Pupa. Pupated June 15. All went below the surface of the soil within an hour or so. Colour dull mahogany brown, cremaster shining, black, with two short, stout outwardly curved hooks. Length 14 mm. by 4 mm. The pupa is enclosed in a cocoon made of loosely cemented soil particles just below the surface of the ground.

Imagines. Nearly all emerged on July 8th almost at the same time. With about 60 arriving at once the rearing box presented a lively appearance.

Remarks. The ova hatched in seven days from time of laying. The larval period was 19 days, while the pupal life was completed in 23 days, making a total of 49 days from egg to adult. From the 75 ova obtained, 57 adults were reared. Of these, 29 were typical *meadi* and 28 were of the form *badiaria* with no intermediate grades. Sexes were indiscriminately distributed among the two forms, with males predominating.

With such a marked distinction the name *badiaria* is a convenient term to distinguish this colour phase from typical *meadi,* the colour form from which the original description was drawn. The uniformity with which the larvae developed, pupated and the adults emerged, each stage at about

the same time almost to the minute, is rather remarkable under confinement.

An attempt to mate the moths was unsuccessful. As this species is apparently single brooded, it is possible that mating would be delayed until the following spring, as the female *meadi f. badiaria* from which the ova were obtained was very worn and minus a hind wing, evidently a hibernated specimen.

TWO DECADES OF HOUSEHOLD PESTS IN VANCOUVER: A SUMMARY OF ENQUIRIES

G. J. SPENCER
University of British Columbia, Vancouver, B.C.

There are certain unavoidable imperfections in these records.

1. Citizens of this Province and of Vancouver have been slow to realize that they can get a measure of help from the University in connection with their insect problems.
2. Many enquiries have come in and have been answered over the telephone: only in later years have some of these messages been recorded.
3. Those recorded have been mostly letters sent to enquirers, of which carbon copies are on file.
4. While 95 per cent. of these records are from Vancouver, I have purposely included some from other points in the Province to show the spread of an insect or its distribution.
5. Most of the enquiries come in during the summer months when I am away on field work.

With the University becoming better known, the volume of enquiries is steadily increasing until now they average 30 to 40 per month throughout the academic year. Some of these enquiries sent to The Entomologist, credit me with encyclopedic knowledge; some I can hand to other members of our Department, but the rest I have to answer. Samples of these are:—

Types of questions sent in to an Entomologist

How to remove moss from roofs.
What rotifers occur in moss on roofs?
How to prevent woodpeckers drilling in roofs and pigeons from fouling cornices.
Will carpenter bees in nail holes in walls and between shingles on roofs destroy the house?

Concerning insects brought into houses on cut flowers or leaves, aphids, thrips, blotches on holly leaves, borers in rose stems, *Leptoglossus* on holly, aphids and scale on ferns.

Odd insects flying in, esp. *Polyphylla crinita* Lec.
Horn-tails being attracted to gas works.
During war years, "how to raise silk?"
How to remove toads, snakes and moles from gardens.
How to tell sexes of guinea fowl and muskrat.
How to remove flies and mites from mushroom beds.
Mites in honey-bee colonies and on earthworm cultures.
How to remove swarms of honeybees from gardens.
How to rear frogs and toads and to start earthworm farms.
Why has a moose a bell?
Why are there no skunks in central B.C.? and so on.

Therefore the following records are cut down heavily to include only those affecting homes, in one way or another.

In view of the above-mentioned imperfections in these records, I can give you only an *idea* of what household pests occur in Vancouver; it is at best, only an *indication* and therefore curves or histograms of records are of little use and are consequently omitted and the enquiries are grouped into topics or categories.

Categories of Enquiries

	Species Concerned
Pests of the *Fabric* of homes	7
Pests attacking man's food	16
Pests of clothing and furniture	9
Pests attacking man's person	8
Pests on household animals or pets	3
Stragglers into homes	33
A total of	76 categories or species

and in addition there are 214 identifications of various sorts.

Insects attacking the **Fabric of Homes** are carpenter ants, termites, Anobiid beetles of two species, the beetle *Buprestis aurulenta* L. the longicorn *Criocephalus productus* Lec. and beetles of the genus *Lyctus*.

During 12 years out of 20, there were 55 enquiries about carpenter ants, 10 each year in 1951 and 1953 and the number is steadily increasing, reported chiefly from old houses. Of termites, there are 89 enquiries: all but one concern *Zootermopsis angusticollis* (Hagen), the one received two weeks ago is *Z nevadensis* (Hagen). Faulty construction in houses whereby the woodwork touches the earth, are responsible for most of the damage although I have four records where the colonies became established completely away from contact with the ground. Here again, the damage is increasing very heavily; in 1950 there were 12 enquiries, in 1951, 17; in 1952, 10 and so far this year 1953 there have been eleven. In many cases the damage both from black carpenter ants and from termites, has been very serious, necessitating extensive and very expensive repairs to buildings. I have a 4-ft. piece of an 8 x 10 foundation pillar from an apartment house where the inside has been completely hollowed out by termites leaving a shell, in places less than 1/8 in. thick. Anobiid or death watch beetles are also becoming of prime importance in homes. The European death watch, *Anobium punctatum* Deg., generally starts from antique furniture imported from Europe and spreads to the fabric of the house itself. I have ten records of this beetle, four in furniture alone and six in walls, but in two instances the infestation did *not* arise from heirloom furniture; the beetles apparently flew in from outside. There are 15 species of Anobiidae in the University collections, ten connected with timber of which four are on the coast and six spp. in the interior. The species that is spreading badly in Vancouver is *Coelostethus quadrulus* (Lec.) which is attracted to homes where the wood-destroying fungi *Merulius lacrymans* (Wulf.) and *Poria* spp. have produced dry rot. So far I have 23 records of infestations of *C. quadrulus* (Lec.) in Vancouver, one involving the entire house. In places where dry rot is not concerned, sapwood only is affected; heart wood is not attacked. *Buprestis aurulenta* L. originates usually in logs and the grubs that have been missed by the saws develop in the timbers, sometimes emerging as beetles from 14 to 18 years after the house was built. I have 14 records of these beetles emerging from buildings, the latest one, received this year from Port Alberni church, where many beetles emerged from floor joists, flooring and especially the pews. The church was completed fifty years ago and the pews were installed at that time. This is surely a world's record for slowness of development of any insect.

The longicorn, *Criocephalus productus* Lec., originated in fire-scorched trees, and four buildings constructed from timber from these trees, were riddled by larvae and emerging adults.

Lyctus beetles emerged from three homes where oak flooring, imported from the southern States during the war, had not been dry kilned.

Insects on **man's food** include about 20 common species; four spp. of spider beetles, the drugstore beetle, *Tribolium*, the saw-toothed grain beetle, granary and rice weevils, Mediterranean flour moth, *Plodia*, the bean weevil, cockroaches, ants, red-legged ham and larder beetles, book lice and mites on cereals and mites on cheese and dried fish. Almost all of the total of 104 records of spider beetles involve *Ptinus tectus* (Boield) (=*Ptinus ocellus* Brown) which, with 49 records of

drugstore beetles, almost always start from cans of paprika and other spices and spread to other foodstuffs. Just this year I have four definite records of *P. ocellus* occurring in carpets in considerable numbers where the grubs must have been feeding on trash deep inside the pile because they normally do not eat keratin. The drugstore beetle also is brought into houses in spice tins and packages of cereals and once did great damage to the herbarium of our university, completely destroying flowers and leaves of many pressed plants. The German cockroach is reported almost every year, as are ants in pantries. I have definitely identified Pharoah's ant only once with two more records of probably this species: the other records are of ants native to this Province. The 12 other insects in this category are of minor importance though some of them, such as the bean weevil, are sometimes very abundant when they do occur.

Insects attacking **clothing and furniture** consists of the varied carpet beetle, the black carpet beetle and the eastern buffalo carpet beetle: clothes moths, spider beetles (as recorded above), silver fish, *Perimegatoma vespulae* Mill., and *Anobium punctatum* Deg. in the wood of furniture. The varied carpet beetle, *Anthrenus verbasci* (L.), with 268 records, is easily the worst household pest in the Province. The first record in 1934 was of five larvae brought into Vancouver from an auto camp on Vancouver Island and from these five I have maintained colonies in tins every year since, but from 1938 onwards it has been sent in from this city, from most of the lower mainland, Victoria, the Okanagan and as far east as Creston and Trail. Reared in the laboratory with abundant food, there are two generations a year but usually only one in homes; in some years *two* broods per year develop in homes. In 1951 there were 74 enquiries about this pest and so far this year there have been 61; ten enquiries came in on one morning the second week in November.

The black carpet beetle was first reported from Vancouver in 1944, with 22 records up to now, nine in 1951 and four so far in 1953. It is slowly spreading in the city although it is quite common in the dry belt, as at Kamloops. The eastern buffalo carpet beetle is established at Haney and at Mission some 50 miles from Vancouver with one record from Vancouver, and it will not be long before it spreads in this city.

Twenty years ago clothes moths were the chief household pest locally but they almost completely faded out when D.D.T. came on the market, being reported only one to three times a year, but they jumped back in 1951 when seven complaints about them came in. It would appear that these two moths have developed a measure of resistance to D.D.T.

Silver fish are spreading slowly but surely, with 25 records, the highest being five in 1951. Both *Lepisma saccharina* L. and *Thermobia domestica* (Pack.) are represented. Psocids or book lice have been reported 13 times and cause annoyance and hysteria out of all proportion to their size when they flood all over a house and are very difficult to eradicate. The newest household pest is the dermestid *Perimegatoma* (or *Megatoma*) *vespulae* Milliron which is common in the dry belt at Kamloops, but has been sent in from Vancouver twice, in 1949 and 1953. For some years it was a menace to the university insect collections, having been introduced in dried insects brought down from Kamloops but it was eradicated in 1951. Last year, however, it came down from the dry belt in great bundles of pressed plants collected in the interior and developed into a serious threat, eating the flowers of dried plants, especially those of *Ranunculaceae*. This summer the herbarium collections had to be fumigated against it.

On **human beings,** 10 species occur—the human flea, cat and dog fleas, ticks, itch mites, bedbugs, body and crab lice and rat and poultry mites. The *human flea* has been reported in nine out of 20 years with not more than two reports of it in any one year. But in several parts of eastern Vancouver

Island, chiefly Qualicum and Sydney, It sometimes develops in tremendous numbers on sea beaches. There are 119 reports of cat and dog fleas, of which 44 occurred in the year 1940, when people became conscious of it after a broadcast on fleas. One or other of the two species (or both) has been reported for 17 years out of 20. This climate is well suited to these insects which sometimes develop to plague proportions in a house. There have been 19 records of bedbugs with no reports at all from 1947 to 1950; only five since then: it is possible that these insects also are becoming resistant to D.D.T. Body lice are unusual with only two records; but one, in 1946 was outstanding because the almost unbelievable hordes of these insects were a contributing factor to the death of an old man living alone in a cabin. Both rat mites and poultry mites on pigeons, developing in the nests of these animals, sometimes swarm out and spread over buildings; such invasions have been reported six times.

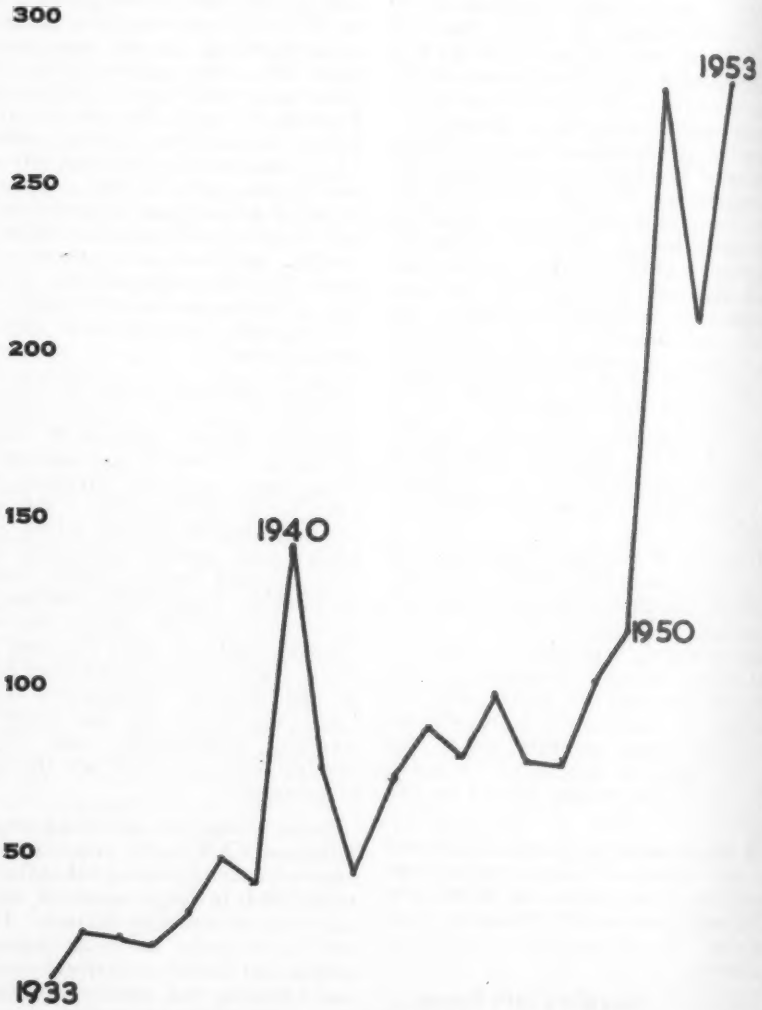
There are 34 records of ticks, almost all of the coast tick with one only (1953) of the Rocky Mountain spotted fever tick, *Dermacentor andersoni* Stiles (*venustus* Marx), attaching to a woman on Fraser Avenue in Vancouver when she was out of the house for ten minutes. Nobody in the house and no neighbours had recently been upcountry and the origin of this dry belt tick in Vancouver, cannot be explained.

On house pests, ear mites of dogs and cats are common; mange mites and puppy lice and mites on birds are occasionally reported. Fleas on cats and dogs are, of course, of perennial occurrence.

The list of **stragglers into homes** is large, with complaints of spiders and ants heading the list. Spiders have been reported for 17 years and ants for eleven years, the invasions of ants generally occurring in new houses, when their homes having been disrupted the insects wander in all directions for some days and straggle into buildings. House flies are so taken for granted that there were only 11 complaints about them, five in 1939, one in 1950, two in 1952, and three in 1953. There are two definite reports of resistance to D.D.T. in houseflies in 1953, one from a packing house in this city where the management spent $1,000 in vain last year, and the other from the sanitarium at Tranquille near Kamloops. This autumn I received details of myiasis by the lesser house fly, *Fannia canicularis* Linn., when a large number of larvae was discharged from the urinary passages of a five-year old girl. In 1952 one record from North Vancouver concerned two successive broods of the house fly, *Musca domestica* L., developing in the mattress of a baby's crib: the resulting adults were only half normal size.

Other *invaders* of homes are constantly reported but are of very minor importance, several species of Diptera, including *Drosophila,* mosquitoes and black flies; sowbugs, earwigs, wasps and wasps' nests, mud wasp nests, pseudoscorpions, *Bryobia* mites, caterpillars and moths, European house crickets and native black crickets, *Tropidischia xanthostoma* Scudder, the giant cave cricket and smaller camel crickets; bedbugs from bats and swallows, great flights of ladybird beetles in the autumn (*Hippodamia ambigua* Lec.), the black vine and strawberry weevils, Collembola, and carabid beetles seeking shelter for the winter in basements.

Some stragglers or invaders merit attention. I have 25 records of Case bearer larvae appearing for eight years since 1944, in large numbers, migrating from trees near houses. I have fed these larvae on scale insects on willow and find them actively carnivorous, cleaning out sheets of scale and even eating the wax of scales, but have never succeeded in rearing the moths. Millipedes have 24 times invaded houses in huge numbers, migrating from woods alongside of newly erected houses. In the four years 1938, 1944, 1945 and in 1952, parts of the city were invaded by *Nomius pygmaeus* (Dej.), the stink beetle,



ANNUAL TOTALS OF ENQUIRIES 1933–1953

which rendered homes untenable for days until I found out that chlorine will neutralize their appalling odour.

A distinct phase of invaders are those that come into homes with firewood—some breeding in the wood, like Nitidulidae; bark beetles, like *Pseudohylesinus;* wood eaters as *Ergates spiculatus* Lec., buprestid larvae and Bostrichidae; carabid beetles, and sow bugs. The borings or tunnels of the shipworm teredo, *Bankia* sometimes cause alarm when they are apparent in firewood.

Not insects, but *rats*, have been reported 27 times; citizens apparently class them with insects, as household vermin.

Finally, I must comment on the attitude of people since 1945, towards insects in general. The whole attitude of citizens has changed; they have become *too* insect conscious and demand relief by the use of chemicals, from innocuous, inconsequential and even useful insects. Hysteria caused by the presence of insects, is increasing: I have now 16 case histories of "insectophobia" varying from unwarranted loathing, to hysteria, to mental unbalance necessitating long periods in mental hospitals. If taken early, these cases can be cured by commonsense appeal and reasoning, but the more severe ones are tragic and pitiable, necessitating phychiatric treatment and hospitalization. Much of this hysteria can be laid to awareness of modern insecticides which is inducing people to want to get rid of ALL insects, everywhere.

SCIENCE NOTE

Notes on the Occurrence of the Painted Lady, *Vanessa cardui L.* on Vancouver and the Queen Charlotte Islands in 1952.

This cosmopolitan species, well known for its unpredictable abundance or scarcity from one year to another, has been common on Vancouver Island during the season of 1952. Worn specimens were noted early in the spring, evidently having hibernated elsewhere than on the island for the species was not noticed by me during the fall of 1951. These battered and faded individuals were observed continually until near the end of August, when freshly emerged specimens began to appear and remained abundant until well into October. They were very partial to the flowers of thistles, and in gardens, buddlia, scabiosa, asters, dahlias, etc. Individuals of this species were seen everywhere from Island View Beach on the coast to the summit of Mount Arrowsmith and all places in between. Philip Dover of Sandspit, Queen Charlotte Islands, wrote to me stating that to his knowledge he has seen them this year for the first time. They were never seen in as large numbers as reported from time to time in other countries, but occurred here in ones and twos, up to a dozen or two at any one time, throughout the season, and at almost every hour of daylight in suitable weather. From late August to October larvae were frequently found in their little tents on thistles; almost every patch had its quota. All these pupated and emerged in the period August to October of this year. The parasite *Ichneumon rufiventris* Brulle was reared from one pupa. This was named by W. R. Mason at Ottawa.

Up to July 1953 no painted ladies have been seen, although numerous examples of other hibernating species have been noted during February and March.

Have the large number of *cardui* seen late in the fall all died during hibernation or did they migrate elsewhere before finally seeking winter quarters; or did they just die, without hibernating or migrating? So far there is no evidence to show what happened.—*G. A. Hardy.*

The Proceedings of the Entomological Society of British Columbia is published annually. Individual volumes may be had for $1.00. Special rates on sets.

Address: C. L. Neilson, Secretary-Treasurer, Entomological Society of British Columbia, Court House, Vernon, B.C.

A non-aqueous indicator solution at work

The problem of heating and decomposition during formulation of chlorinated hydrocarbon insecticides into wettable powders and dusts is known to occur occasionally. For a long time the reason for these occurrences were not understood. The problem was studied by Shell at Denver, Colorado in relation to DIELDRIN and it was found that decomposition of DIELDRIN at time of manufacture of the powders was closely associated with the acidic surfaces of certain common carriers.

This true acid strength could not be shown by testing a paste or suspension of the carrier in water in the regular way and the use of non-aqueous indicator solutions applied directly to the dry carrier was necessary. Carriers found to have these hitherto unsuspected acid spots were termed catalytically active.

Having found the key to the solution of the problem, it was then a simple matter to determine additives that would counteract or inhibit the catalytic action.

Shell products can be recommended with confidence because of Shell Research.

If further details are required about the foregoing, write to the Chemical Division of the Shell Oil Company of Canada, Limited, Box 400, Terminal "A", Toronto, Ontario.

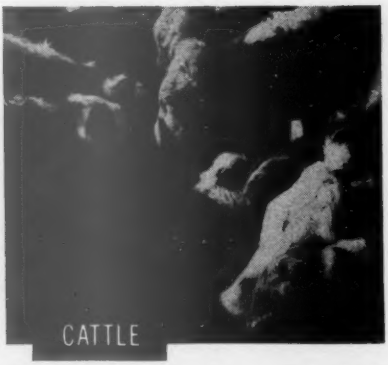
Chemical Division

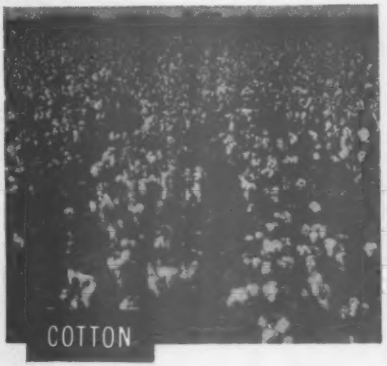
SHELL OIL COMPANY
OF CANADA, LIMITED

SHELL

TOXAPHENE PROTECTS

FOOD, FEED, AND FIBER CROPS





Wherever you live, it's probable that the crops grown there can benefit from insecticides based on toxaphene (chlorinated camphene 67-69% Cl). Recommended for effective control of more than 150 different species of insect pests, toxaphene dusts and sprays are helping to protect food, feed and fiber crops —to increase yields throughout the world.

Naval Stores Department
HERCULES POWDER COMPANY
954 King St. Wilmington 99, Del., U. S. A.

ANSELL LABORATORIES LTD.

VERNON, B.C.

Manufacturers and Distributors of

Chemical Products

INSECTICIDES — CLEANING COMPOUNDS

Special Mixing

PROVEN RELIABLE AND DEPENDABLE

Spares Bees and other beneficial Insects

"Black Leaf 40"

Leaves no objectionable residue on flowers, foliage or fruit

The Original Nicotine Sulphate Insecticide

Canadian Sales Representatives
Dunn Sales Limited, Montreal, Toronto, Winnipeg, Vancouver

ZEISS MICROSCOPES

Stereo
Standard
Phase Contrast
Model W
Standard Junior
Metallurgical
Polarizing

HALIFAX
MONTREAL
HAMILTON
WINNIPEG

THE

HUGHES-OWENS

COMPANY LIMITED

OTTAWA
TORONTO
EDMONTON
VANCOUVER

Notes - typed - printed - handwritten or with illustrations reproduced photographically (unless copyrighted) — Ask for sample.

PHOTO COPY REPRODUCTION

Niagara's *planned* protection program assures Western growers of top profits from every crop for *two* reasons. First is the skill and experience of research chemists, entomologists and trained laboratory workers, expressed in the superior control powers of Niagara materials. Second is the expert knowledge of local growing conditions and infestations, supplied by Niagara Field Representatives. This combination, checked and proven by years of actual use, gives doubled-barreled results in reduced damage from insects and disease, plus higher profits from more top quality fruit, produce, and livestock.

Niagara offers Western growers additional help through a series of Field Service Bulletins which contain local insect and disease control recommendations for every crop in every agricultural region. If you wish copies for your own information, without obligation, write Niagara Chemical Division, Richmond, Calif., Dept. 251.

INSECTICIDES • FUNGICIDES • HERBICIDES • LIVESTOCK SPRAYS & DIPS

Niagara CHEMICAL DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

RICHMOND, CALIFORNIA • HOME OFFICE — MIDDLEPORT, NEW YORK

Products for Agriculture from borates

. . . BY THE MANUFACTURERS OF FAMOUS "20 MULE TEAM" PACKAGE PRODUCTS

HERBICIDES

CONCENTRATED BORASCU R

POLYBOR-CHLORATE R

FERTILIZERS

FERTILIZER BORATES
Regular and High Grade

POLYBOR-2

ANHYDROUS RASORITE

. . . for correcting boron deficiency

BORATES

BORAX

BORIC ACID

and every form of borates for every possible

PACIFIC COAST BORAX CO

DIVISION OF BORAX CONSOLIDATED LIMITED

Canadian Sales Office

2031 40th Avenue S.W.
Calgary, Alberta

Represented by

R. A. HARVEY

Agents: Macdonald & Wilson, Ltd., Naugatuck Chemicals, Allied Chemicals Services,